State of Connecticut

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263

THIRTIETH ANNUAL REPORT

OF

# The Connecticut Agricultural Experiment Station

FOR THE YEAR ENDING OCTOBER 31

1906

3500
17 JUN 1936

*PRINTED BY ORDER OF THE LEGISLATURE*

**The publications of this Station are sent free to every citizen of Connecticut who applies for them. Address, The Conn. Agricultural Experiment Station, New Haven, Conn.**

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1907

PUBLICATION

APPROVED BY

THE BOARD OF CONTROL.

# CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

## OFFICERS AND STAFF

FOR THE YEAR ENDING OCTOBER 31, 1906.

### STATE BOARD OF CONTROL.

*Ex officio.*

His Excellency HENRY ROBERTS, Hartford, *President.*
E. H. JENKINS, New Haven, *Director and Treasurer.*

| | Term Expires |
|---|---|
| *Appointed by State Agricultural Society:* | |
| B. W. COLLINS, Meriden. | July 1, 1909 |
| *Appointed by Board of Trustees of Wesleyan University:* | |
| Prof. F. G. BENEDICT, Middletown. | 1909 |
| *Appointed by Governor:* | |
| EDWIN HOYT, New Canaan. | 1907 |
| JAMES H. WEBB, Hamden. | 1908 |
| *Appointed by Board of Agriculture:* | |
| T. S. GOLD,* West Cornwall, *Vice President.* | 1907 |
| *Appointed by Governing Board of Sheffield Scientific School:* | |
| W. H. BREWER, New Haven, *Secretary.* | 1908 |

### STATION STAFF.

*Chemists.*
*Analytical Laboratory.*

A. L. WINTON, PH.D., *Chemist in charge.*
E. MONROE BAILEY, PH.B. J. L. KREIDER, M.A.†
KATE G. BARBER, PH.D. E. J. SHANLEY, PH.B.

*Laboratory for the Study of Proteids.*
T. B. OSBORNE, PH.D., *Chemist in charge.* I. F. HARRIS, M.S.

*Botanist.*
G. P. CLINTON, S.D.

*Entomologist.*
W. E. BRITTON, PH.D.

*Assistant to the Entomologist.*
B. H. WALDEN, B.AGR.

*Forester.*
AUSTIN F. HAWES, M.F.

*Agronomist.*
EDWARD M. EAST, M.S.

*Grass Gardener.*
JAMES B. OLCOTT, *South Manchester.*

*Stenographers and Clerks.*
MISS V. E. COLE.
MISS L. M. BRAUTLECHT.

*In charge of Buildings and Grounds.*
WILLIAM VEITCH.

*Laboratory Helper.*
HUGO LANGE.

*Sampling Agent.*
V. L. CHURCHILL, New Haven.

* Died March 20, 1906 and succeeded by CHARLES M. JARVIS, Berlin.
† Till Sept. 1, 1906.

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# ANNOUNCEMENT.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION was established by an Act of the General Assembly approved March 21, 1877, "for the purpose of promoting Agriculture by scientific investigation and experiment."

By subsequent legislative acts it is made the business of this station to analyze all the brands of commercial fertilizers sold in the state, as well as to examine commercial cattle feeds and articles used for human food or drink on sale in Connecticut, with reference to their adulterations. Provision is also made for the testing and marking by this station of all apparatus used in determining the price of milk and cream.

Through the state entomologist, a member of the station staff, the station is required to make regular inspections of nurseries, to visit and examine orchards, nurseries, fields, gardens, or storehouses, at the request of their owners, to advise regarding treatment for insect pests and to diffuse information on the subject.

Through the state forester, also a member of its staff, the station is required to manage the state forest.

In addition to the work of "scientific investigation and experiment" in the service of agriculture, to the work required under special statutes above described, and to the expert work required by the dairy commissioner's office, the station analyzes and tests fertilizers, cattle-foods, seeds, milk and other agricultural materials and products, identifies grasses, weeds, moulds, blights, mildews, useful or injurious insects, suggests methods of combating injurious fungous and insect pests, advises as to the planting, management and care of woodland, etc., and gives information on various subjects of agricultural science, for the use and advantage of the citizens of Connecticut.

The station does not make sanitary analyses of water, as that work has been undertaken by the State Board of Health.

The station makes analyses of fertilizers, feeds, and oth( products, tests seeds, etc., for the citizens of Connecticut, witl out charge, provided—

1. That the results are of use to the public and are fre to publish.

2. That the samples are taken from stock now in the market and in accordance with the station "Instructions fo: Sampling."

3. That the samples are fully described and retail prices given on the station "Forms of Description."

4. That it is physically possible for the station to do the work in a reasonable time.

Results of analysis or investigation that are of general interest are published in bulletins, of which copies are sent to every citizen of the state who applies for them, as far as the editions will permit. These results are summed up in the annual reports made to the Governor.

It is the wish of the Board of Control to make the station as widely useful as its resources will permit. Every Connecticut citizen who is concerned in agriculture, whether farmer, manufacturer, or dealer, has the right to apply to the station for any assistance that comes within its province to render, and the station will respond to all applications as far as lies in its power.

Instructions and forms for taking samples will be sent on application.

Parcels by express should be prepaid and marked with the name of the sender. Communications should be directed to the

AGRICULTURAL EXPERIMENT STATION,

NEW HAVEN, CONN.

The station grounds, laboratories and office are at 123 Huntington street, between Whitney avenue and Prospect street, 1⅝ miles north of City Hall. Huntington street may be reached by the Mt. Carmel and Whitney avenue electric cars, which pass the railway station every twelve minutes.

The station has telephone connection and may be spoken from all parts of the state at all hours between 7.30 A. M. and 9.30 P. M.

VISITORS ARE ALWAYS WELCOME.

# REPORT OF THE BOARD OF CONTROL

OF THE

## CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

*To His Excellency, Henry Roberts, Governor of Connecticut:*

The Board of Control of the Connecticut Agricultural Experiment Station, as required by law, herewith respectfully submits its report for the year ending October 31, 1906.

During the present year, the Board has lost one of its members by death. With reference to this event, the following minute was unanimously adopted at the meeting of the Board, June 14, 1906:

"The Hon. Theodore Sedgwick Gold, a member of this Board, died at his home in West Cornwall, Connecticut, on March 20th, 1906, at the age of 88.

Mr. Gold was a member of this Board and its vice president from the time the Connecticut Agricultural Station was established until the time of his death. For nearly thirty years his thorough acquaintance with the agriculture of the State, his practical knowledge and experience as a farmer, and his sagacity as a counselor, made his judgment and advice of especial value to his associates on this Board.

No other man in the State has so long, so continuously and in such a number of ways served and promoted Connecticut farm interests.

For twenty-four years, beginning in 1845, he himself conducted a farm school. He was one of the organizers of the Connecticut Agricultural Society in 1853, of the State Board of Agriculture in 1866, of the Connecticut Agricultural Experiment Station in 1875-1877, and of the Storrs Agricultural School in 1887, and he served each of these organizations actively and effectively as a faithful official as long as he was connected with it.

This Board desires to record its grateful appreciation of Mr. Gold's sterling character and of his unabated energy and interest in all that affected the agriculture of Connecticut, and especially of his wisdom and helpfulness in guiding the policy of this Station.

It is ordered that this minute be entered on the records of the Board and that a copy be sent to Mr. Gold's family."

The State Board of Agriculture has appointed Mr. Charles M. Jarvis, of Berlin, to fill the vacancy on this Board caused by the death of Mr. Gold.

On September 1st, Mr. J. L. Kreider, who has served the station acceptably as chemist for one year, resigned to go into business.

The Congress of the United States, by an Act approved March 16, 1906, known as the Adams Act, appropriated five thousand dollars to each state and territory "for the more complete endowment and maintenance of agricultural experiment stations now established or which may hereafter be established in accordance with the Act of Congress approved March second, eighteen hundred and eighty-seven," and also appropriated an annual increase of $2,000 until the sum should equal $15,000 annually in addition to the appropriation under the Hatch Act.

The act provides that this money shall be "applied only to paying the necessary expenses of conducting original researches or experiments bearing directly on the agricultural industry of the United States."

It is further provided that the Secretary of Agriculture shall ascertain and certify to the Secretary of the Treasury whether each state is complying with the provisions of this Act and is entitled to receive its share of the annual appropriation, and the amount to which each is entitled.

The United States Secretary of Agriculture, undertaking the administration of the law, has issued a circular of instructions, which is here reproduced in part:

"Under the terms of the Act, it will be necessary that a separate account of the Adams fund shall be kept at each station, which should be open at all times to the inspection of the Director of the Office of Experiment Stations, or his accredited representative.

In the interpretation of this Act and the examination of the work an expenditures of the stations under it, I have instructed the Director o the Office of Experiment Stations to be guided by the followin principles:'

The Adams fund is 'to be applied only to paying the necessary expense of conducting original researches or experiments bearing directly o the agricultural industry of the United States.' It is for the 'mor complete endowment and maintenance' of the experiment stations, pr supposing the provision of a working plant and administrative officer Accordingly, expenses for administration, care of buildings and ground insurance, office furniture and fittings, general maintenance of th station farm and animals, verification and demonstration experiment compilations, farmers' institute work, traveling, except as is imm

diately connected with original researches in progress under this Act, and other general expenses for the maintenance of the experiment stations, are not to be charged to this fund. The Act makes no provision for printing or for the distribution of publications, which should be charged to other funds.

In order that there may be no doubt as to the disposal of the Adams fund, each station should outline a definite program of experimental work to which it will devote this fund, and expenses for other work should not be charged to it. The work contemplated by this Act will, as a rule, necessarily cover more than one year, and changes in the program once adopted should not be made until the problems under investigation have been solved, or their solution definitely shown to be impracticable. This will give ample opportunity for making plans for winding up any particular piece of work and beginning another with such deliberation as will provide for the suitable and economical expenditure of this fund without resort to doubtful expedients or expenditures. It is much to be desired that this fund shall be a strong incentive to the careful choice of problems to be investigated, thorough and exhaustive work in their solution, and the securing of permanent and far-reaching results on which can be safely based demonstration and verification experiments leading to the general improvement of farm practice in many particulars."

The Governor of the State, as provided by the Act of Congress, accepted the above grant and directed that until June 30, 1907, one-half of the fund, like the Hatch fund, should be given to the Storrs Agricultural Experiment Station and one-half to the Connecticut Agricultural Experiment Station.

This station has, therefore, submitted a plan for research work on the principles and practice of plant selection and breeding with special reference to two of our staple crops—corn and potatoes,—covering a course of several years, which plan has been accepted by the Washington authorities.

The work done by the chemical department under the immediate direction of the chemist in charge, Dr. Winton, may be summarized as follows:

In 1906, thirty-eight firms and individuals have entered for sale in the state two hundred and eighty-eight distinct brands of commercial fertilizers. During the spring, Mr. Churchill visited ninety-four towns and villages and drew five hundred and fifty-eight samples of these fertilizers. As required by law, all the brands thus sampled have been analyzed. The results of this work, making Part I of the station report, are waiting for the order of the Comptroller to print.

Under the provisions of the law regarding food products, Mr. Churchill visited twenty-eight towns and villages and bought twelve hundred and seventy-four samples of food products which have been examined, and those which were adulterated promptly reported to the Dairy Commissioner, with whom rests the enforcement of the law.

Three hundred and eighty-two other samples of food products from various sources have been examined, and for the Dairy Commissioner six hundred and ninety-one samples, making the total number examined twenty-three hundred and forty-seven.

This work has been wholly in charge of Dr. Winton, who has prepared the results for publication as Part II of the station report.

Under the terms of the law regarding commercial feeds, two hundred and ninety-eight samples were collected from the Connecticut market and analyzed, the results being published as Part III of the Report for 1906. Two hundred and thirty samples of feed have been collected during the last month and are now being examined.

Three hundred and eighty-one samples of field and garden seeds have been tested by Mr. Churchill, with reference to their vitality, at the request of seedsmen and others.

Dr. Osborne has continued his studies on the vegetable proteids, assisted by a grant from the Carnegie Institution. The results of his work are given in the papers named below.

Dr. Clinton, botanist of the station, has studied the preventive treatment of "onion brittle," a destructive trouble which has appeared in Guilford; a dry rot fungus which was destroying the woodwork of a church; root-rot and other diseases of tobacco, and the relation of a fungus on asters and goldenrod with one which attacks pine trees. He has also continued his extensive study, begun some years ago, of the life history of the fungus which causes potato blight and rot and the best methods of combatting it. He has also carried on miscellaneous spraying experiments for the treatment of other fungous diseases.

Some sixty specimens of fungi have been received from farmers for identification and for advice regarding their treatment.

The above work has supplied about the usual number of named species which were new to the Station herbarium.

The station entomologist, Dr. Britton, has, in accordance with the law regarding insect pests, officially inspected all the nurseries of the state, giving certificates to those found free from dangerous insect pests, destroying infested stock, and advising necessary treatment. Other inspections of orchards have been made when called for.

Over 1,000 fruit trees in different parts of the state have been sprayed to determine the value of different preparations for the destruction of San José scale.

Dr. Britton has identified and determined the life history of the maple-leaf stem borer, a new pest of the sugar maple, previously undescribed.

The study of the tobacco insects of Connecticut has been continued.

Two hundred and seventy-nine insect species have been identified for correspondents, and advice given as to treatment to check their depredations.

The discovery of the dreaded gypsy moth at Stonington has made an unusual demand on the time and resources of the entomologist. Before the first of May, the brush was cut and burned on 5 acres known to be infested and thirty egg masses were destroyed. Over 1,500 trees were banded and examined throughout the summer, and about 10,000 of the caterpillars destroyed. About forty new egg masses were destroyed after August 1st. Much work has been done in clearing land of brush and thus preventing a further increase of the infected area as well as facilitating the work of extermination within this area. The State Board of Agriculture has contributed $800 to meet a part of the expense of this work.

Mr. Hawes, the station forester, has established a nursery on the Clark field at Rainbow, sowed about sixty pounds of tree seed, and now has about 500,000 tree seedlings, chiefly white, Scotch and Norway pine. About 18,000 pine, spruce, and maple seedlings have been set in the Clark field, and 6,300 in Mundy Hollow. About 20,000 seedlings have been sold at cost for planting on forest areas in Connecticut. Some fifteen bushels of white and red oak acorns have been gathered and planted or stored for spring planting.

Acting as state forester, Mr. Hawes has set 20,000 p on about fifteen acres of the new State Forest in the t of Union. Another 20,000 seedlings are in beds ready tc in the forest. About fifty-five acres have been added to State Forest at Portland and a considerable amount of impr ment cutting has been done. No damage has been don fire owing to the efficiency of the forest warden, Mr. Reeves.

The station, in coöperation with the Bureau of Industry of the U. S. Department of Agriculture, throug agent, Mr. A. D. Shamel, has continued the work of atten improvement of our domestic tobacco leaf by selection hybridizing. This work has been done at Granby, East ford, Suffield and New Milford, with the coöperatic growers.

Mr. East, the station agronomist, has begun a study o sibilities and methods of improving potatoes in yield, q nutritive value and disease resistance by selection and bre

During the year he has managed a breeding plot for in ing yield and sugar content of Stowell's Evergreen sweet and a breeding plot for increase in yield and protein c of a twelve-rowed flint corn.

Eleven breeding plots of dent, flint and sweet corns hav managed in coöperation with as many growers—in t which selections have been made for increase of prot well as yield.

In connection with Mr. East's breeding work a study i made of the improvement of a common type of sandy l means of a rotation, including the use of leguminous crc the moderate use of fertilizers.

An Act of the General Assembly, session of 1904, pr that the State Board of Control should determine bc maximum limit of pages in the reports of state inst and also the number of copies printed. Under this l Board reduced the edition of the report of this statio twelve thousand to nine thousand, and the maximum l pages from 500, allowed by statute, to 375. This re prevented publication of the results of a part of the w the year 1905.

The State Board has authorized the printing of 475 pages of the report of 1906.

The report of 1905 is a volume of 368 pages with 28 plates.

During the year there have also been issued three bulletins, aggregating 73 pages with 11 plates, and one "bulletin of immediate information" of 4 pages.

The number of letters and manuscript reports sent during the year by members of the staff has exceeded 5,900.

During the year, members of the staff have addressed fifty-two meetings of farmers and farmers' organizations.

Several exhibits have also been made at fairs and annual meetings of the Pomological Society and of the Board of Agriculture.

In addition to station publications, the following papers, which were too technical or too extended for the station reports, have been published by the station staff in the journals named:

A. L. Winton and J. L. Kreider. A Method for the Determination of the Lead Number in Maple Syrup and Maple Sugar. Journal of the American Chemical Society, Vol. XXVIII, pp. 1204-1209.

Thomas B. Osborne and Ralph D. Gilbert. The Proportion of Glutaminic Acid Yielded by Various Vegetable Proteins when Decomposed by Boiling with Hydrochloric Acid. American Journal of Physiology, 1906, Vol. XV, pp. 333-356.

Thomas B. Osborne and Isaac F. Harris. The Chemistry of the Protein Bodies of the Wheat Kernel; Part II, Preparation of the Proteins in Quality for Hydrolysis. American Journal of Physiology, 1906, Vol. XVII, pp. 223-230.

Thomas B. Osborne and S. H. Clapp. The Chemistry of the Protein Bodies of the Wheat Kernel; Part III. Hydrolysis of the Wheat Proteins. American Journal of Physiology, Vol. XVII, pp. 231-265.

Dr. G. P. Clinton. Report on the Fungous Diseases of Fruit in 1905. Report of the State Pomological Society.

Dr. G. P. Clinton. An extensive monograph of 82 quarto pages on the Ustilagineae, published by the New York Botanical Garden as Part I, Vol. 7, of the North American Flora, being the first publication on the fungi, of this standard work.

Dr. W. E. Britton. Some New or Little Known Aleyrodidae of Connecticut. *Entomological News*, Vol. XVII, pp. 127-130

Dr. W. E. Britton. Tests of Lime-Sulphur Washes in Connecticut in 1905, and Destroying the Woolly Maple Leaf Scale by Spraying, two papers read before the Association of Economic Entomologists and printed in the Proceedings.

Dr. W. E. Britton. The Common House Fly in its Relation to Public Health, an address before the health officers of Connecticut. Yale Medical Journal, Vol. XII, pp. 750-757.

This Board has held three meetings as follows,—the annual meeting at Hartford, January 16th, the regular spring meeting at New Haven, June 4th, and a special meeting at Hartford and South Manchester, June 16th.

The executive committee of the Board has held seven formal meetings besides several informal conferences.

The treasurer's accounts for the state fiscal year ending September 30th have been duly examined by the state auditors and found correct.

All of which is respectfully submitted.

(Signed) WM. H. BREWER, *Secretary.*

NEW HAVEN, CONN., November 1, 1906.

# REPORT OF THE TREASURER.

E. H. Jenkins, in account with The Connecticut Agricultural Experiment Station for the fiscal year ending September 30, 1906.

RECEIPTS.

| | | | |
|---|---|---|---|
| Balance on hand, October 1, 1905: | | | |
| Analysis Fees | $ 70.64 | | |
| Insect Pest Fund | 450.00 | | |
| | | | $520.64 |
| State Appropriation, Agriculture | | $10,000.00 | |
| State Appropriation, Food | | 2,500.00 | |
| State Appropriation, Insect Pest | | 3,000.00 | |
| United States Appropriation, Hatch | | 7,500.00 | |
| United States Appropriation, Adams | | 3,375.00 | |
| Analysis Fees | | 19,313.92 | |
| Sale of Tobacco | | 356.49 | |
| Miscellaneous Receipts | | 69.37 | |
| From the Lockwood Estate | | 6,700.00 | |
| | | | 52,814.78 |
| | | | $53,335.42 |

DISBURSEMENTS.

| | | |
|---|---|---|
| E. H. Jenkins, | Salary | $2,800.00 |
| W. H. Brewer, | " | 100.00 |
| V. E. Cole, | " | 800.00 |
| L. M. Brautlecht, | " | 550.00 |
| A. L. Winton, | " | 2,166.67 |
| T. B. Osborne, | " | 2,000.00 |
| I. F. Harris, | " | 500.00 |
| E. Monroe Bailey, | " | 1,300.00 |
| Kate Barber, | " | 366.67 |
| J. L. Kreider, | " | 666.66 |
| E. J. Shanley, | " | 650.00 |
| S. E. Moody, | " | 112.50 |
| W. E. Britton, | " | 1,550.00 |
| G. P. Clinton, | " | 2,000.00 |
| Austin F. Hawes, | " | 1,437.50 |
| E. M. East, | " | 1,700.00 |
| J. B. Olcott, | " | 800.00 |
| H. Lange, | " | 800.00 |
| William Veitch, | " | 600.00 |
| V. L. Churchill, | " | 700.00 |

| | | |
|---|---|---|
| Labor | $ 2,326.15 | |
| Publications | 964.59 | |
| Postage | 150.65 | |
| Stationery | 273.38 | |
| Telephone and Telegraph | 111.93 | |
| Freight and Express | 170.44 | |
| Gas and Kerosene | 302.98 | |
| Coal | 1,221.50 | |
| Water | 188.97 | |
| Chemicals and Laboratory Supplies | 1,341.98 | |
| Agricultural and Horticultural Supplies | 214.93 | |
| Miscellaneous Supplies | 204.23 | |
| Botanical Supplies | 24.26 | |
| Fertilizers | 80.54 | |
| Feeding Stuffs | 98.28 | |
| Library and Periodicals | 723.94 | |
| Tools and Machinery | 567.77 | |
| Furniture and Fixtures | 262.65 | |
| Scientific Apparatus | 1,013.85 | |
| Traveling by the Board | 55.70 | |
| Traveling by the Staff | 512.09 | |
| Tobacco Experiment | 1,098.35 | |
| Fertilizer Sampling | 182.19 | |
| Food Sampling | 358.94 | |
| Insurance | 691.88 | |
| Insect Pest Appropriation to State Entomologist | 2,800.00 | |
| Contingent | 112.08 | |
| Plant Breeding Experiment (to July 1, 1906) | 552.01 | |
| Forestry and Lockwood Expenses | 1,897.63 | |
| Botanical Field Experiment (to July 1, 1906) | 78.95 | |
| Entomological Field Experiment (to July 1, 1906) | 20.50 | |
| New Buildings | 11,567.60 | |
| Betterments | 114.77 | |
| Repairs | 277.56 | |
| | | $52,163.27 |
| Analysis Fees on hand. Sept. 30, 1906 | $522.15 | |
| Insect Pest Funds on hand, Sept. 30, | 650.00 | |
| | | $1,172.15 |
| | | $53,335.42 |

New Haven, Conn., October 25, 1906.

This Certifies that we have examined the accounts of E. H. Jenkins, Treasurer of the Connecticut Agricultural Experiment Station, for the year ending September 30, 1906, compared the same with the vouchers therefor and found them correct.

William P. Bailey,
Edward M. Yeomans,
*Auditors of Public Accounts.*

## PART I.

# Report on Commercial Fertilizers, 1906.

BY E. H. JENKINS, *Director,* and A. L. WINTON, *Chemist in charge of the Analytical Laboratory.*

This station is required by statute to analyze yearly at least one sample of every commercial fertilizer which is offered for sale in the state. "Stable manure and the products of local manufacturers of less value than ten dollars per ton," are excepted.

The station is also required to publish these analyses yearly.

### DUTIES OF MANUFACTURERS AND DEALERS.

The General Statutes, sections 4581 to 4590, inclusive, make the following requirements regarding commercial fertilizers:

1. The seller is responsible for affixing to every package sold, a label which shall correctly give the number of pounds in the package, name of the fertilizer, name and address of manufacturer, place of manufacture and a statement of composition, expressed in a way approved by this station.

Attention is called to the requirement of law that the name of the manufacturer and place of manufacture must be stated on the label. The place of manufacture is the place where the materials which compose the manufactured article are mixed and put together. The manufacturer is the person or firm which owns or controls the manufacturing plant or machinery.

2. The seller is responsible for the payment to the station director, on or before May first, annually, of an analysis fee on every brand sold by him.

3. Before any brand of fertilizer is sold in the state, the agent or seller must file with the director of this station two certified copies of the statement named in 1, and a sealed glass jar containing not less than one pound of the fertilizer, with an affidavit that it is a fair average sample.

The agent or seller is free from the three obligations just stated only in case the manufacturer or importer fulfils them instead.

4. In any case the agent or seller must annually report to the director of this station his name, residence and post office address and the names of the fertilizers which he sells, with the names and addresses of the manufacturers or importers.

Copies of the statutes regarding fertilizers will be sent on application.

The statement of composition referred to in the statute must conform to the following requirements, which are approved by this station:—

*A statement of the percentages of Nitrogen, Phosphoric Acid* ($P_2O_5$) and Potash ($K_2O$), and of their several states or forms, will suffice in most cases. Other ingredients may be named if desired.

In all cases the percentage of *nitrogen* must be stated. Ammonia may also be given when actually present in ammonia salts, and "ammonia equivalent of nitrogen" may likewise be stated.

The percentages of water-soluble and citrate-soluble phosphoric acid may be given separately or together, and the term "available" may be used in addition to, but not instead of, water-soluble and citrate-soluble,

The percentage of insoluble phosphoric acid may be stated or omitted.

In case of bone, fish, tankage, dried meat, dried blood, etc., the statement of chemical composition may take account of the two ingredients, nitrogen and phosphoric acid.

For potash salts the percentage of potash (potassium oxide) must always be given; that of sulphate of potash or muriate of potash may also be stated.

The analysis fee for any brand will usually be ten, twenty or thirty dollars, according as one, two, or all three of the ingredients—nitrogen, phosphoric acid and potash—are contained or claimed to exist in the fertilizer.

## OBSERVANCE OF THE FERTILIZER LAW.

During 1906 thirty-eight individuals or firms have entered for sale in this state two hundred and eighty-eight brands of fertilizers, viz:

| | |
|---|---|
| Special manures for particular crops | 131 |
| Other nitrogenous superphosphates | 100 |
| Bone manures and "bone and potash" | 28 |
| Fish, tankage, castor pomace and chemicals | 29 |
| Total | 288 |

Here follows a list of manufacturers who have paid analysis es as required by the fertilizer law and the names or brands the fertilizers for which fees have been thus paid for the ar ending May 1st, 1907:

| *Firm.* | *Brand of Fertilizer.* |
|---|---|
| an Agricultural Chemical Co., 26 Broadway, N. Y. City. | Bradley's Niagara Phosphate,<br>Eclipse Phosphate,<br>*Farmers' New Method Fertilizer,*<br>Corn Phosphate,<br>Potato Fertilizer,<br>Manure,<br>Superphosphate,<br>Complete Manure for Potatoes and Vegetables,<br>Complete Manure for Top Dressing Grass and Grain,<br>Church's Fish and Potash,<br>Crocker's New Rival Fertilizer,<br>Ammoniated Corn Phosphate,<br>Potato, Hop and Tobacco Fertilizer,<br>Darling's General Fertilizer,<br>Farm Favorite,<br>Potato Manure,<br>Dissolved Bone and Potash,<br>Blood, Bone and Potash,<br>East India A. A. Ammoniated Superphosphate,<br>Potato Manure,<br>Great Eastern General,<br>H. G. Vegetable, Vine and Tobacco Fertilizer,<br>Northern Corn Special,<br>Packers' Union Universal Fertilizer,<br>Potato Manure,<br>Gardeners' Complete Manure,<br>Animal Corn Fertilizer,<br>Quinnipiac Climax Phosphate,<br>Corn Manure,<br>Potato Phosphate,<br>Manure,<br>Phosphate,<br>Market Garden Manure,<br>Read's Practical Potato Special,<br>Standard Superphosphate,<br>Vegetable and Vine Fertilizer, |

| *Firm.* | *Brand of Fertilizer.* |
|---|---|
| American Agricultural Chemical Co., The, 26 Broadway, N. Y. City—*Continued.* | Wheeler's Bermuda Onion Grower,<br>Corn Fertilizer,<br>Potato Manure,<br>Havana Tobacco Grower,<br>Williams & Clark's Americus Corn Ph phate,<br>Americus Potato M nure,<br>Potato Phosphate,<br>Americus Ammo ted Bone Su phosphate,<br>Americus H. G. S cial Fertilizer,<br>Acid Phosphate,<br>Grass and Oats Fertilizer,<br>*H. G. Fertilizer with 10% Potash,*<br>Tobacco Starter and Grower,<br>Grass and Lawn Top Dressing,<br>Southport XX Special,<br>High Grade Tobacco Manure,<br>Complete Tobacco Manure,<br>Castor Pomace,<br>Fine Ground Bone,<br>Dry Ground Fish,<br>Muriate of Potash,<br>Nitrate of Soda,<br>Complete Manure with 10% Potash. |
| Armour Fertilizer Works, The, Baltimore, Md. | Grain Grower,<br>Bone, Blood and Potash,<br>High Grade Potato,<br>All Soluble,<br>Ammoniated Bone with Potash,<br>*Bone Meal,*<br>Complete Potato,<br>Corn King,<br>Market Garden,<br>Fish and Potash,<br>Fruit and Root Crop Special. |
| Baker, H. J., & Bro., 100 William St., N. Y. City. | Castor Pomace. |
| Berkshire Fertilizer Co., Bridgeport, Conn. | Berkshire Complete Fertilizer,<br>Potato and Vegetable Ph phate,<br>Ammoniated Bone Phosph<br>Grass Special,<br>Fine Ground Bone,<br>Tobacco Special. |
| Boardman, F. E., Route 1, Middletown, Conn. | Boardman's Complete Fertilizer for tatoes and General Crops. |
| Bohl, Valentine, Waterbury, Conn. | Self-Recommending Fertilizer,<br>Market Garden Complete Fertilizer. |

| *Firm.* | *Brand of Fertilizer.* |
|---|---|
| ɔwker Fertilizer Co., 81 New St., N. Y. City. | Stockbridge Special Corn Manure, |
| | Potato and Vegetable Manure, |
| | Grass Top Dressing, |
| | Tobacco Manure, |
| | Potato and Vegetable Fertilizer, |
| | Phosphate, |
| | Hill and Drill Phosphate, |
| | Farm and Garden Phosphate, or Ammoniated Bone, |
| | Fisherman's Brand Fish and Potash, |
| | Tobacco Starter, |
| | Ash Elements, |
| | Carbonates, |
| | Complete Alkaline Tobacco Grower, |
| | Sure Crop Phosphate, |
| | Market Garden Fertilizer, |
| | Corn Phosphate, |
| | Early Potato Manure, |
| | Fine Ground Dry Fish, |
| | Fairfield Onion Fertilizer, |
| | Nitrate of Soda, |
| | Muriate of Potash, |
| | Fresh Ground Bone, |
| | Canada Hard Wood Ashes, |
| | Acid Phosphate, |
| | Square Brand Bone and Potash, |
| | Castor Pomace, |
| | Gloucester Fish and Potash, |
| | Middlesex Special, |
| | Potash Bone, |
| | XX Bone, |
| | Lawn and Garden Dressing. |
| ıffalo Fertilizer Co., The, Buffalo, N. Y. | Fish Guano, |
| | Farmers' Choice, |
| | York State Special, |
| | Vegetable and Potato, |
| | Garden Truck, |
| | High Grade Manure, |
| | Bone Meal. |
| ark Co., The Everett B., Milford, Conn. | E. B. C's. Special Mixture for General Use. |
| ɪe-Mortimer Co., The, 133 Front St., N. Y. City. | New Englander Corn and Potato Fertilizer, |
| | High Grade Ammoniated Bone Superphosphate, |
| | Nitrate of Soda, |
| | XXX Pure Ground Bone, |
| | Tobacco and Onion Fertilizer, |
| | Celebrated Special Potato Fertilizer, |
| | Red Brand Excelsior Guano, |
| | Gold Brand Excelsior Guano, |
| | Columbian Corn Fertilizer, |
| | Grass and Grain Special, |
| | Potato Fertilizer. |

| *Firm.* | *Brand of Fertilizer.* |
|---|---|
| Connecticut Fat Rendering & Fertilizer Corporation, New Haven, Conn. | Tankage. |
| Connecticut Valley Orchard Co., The, Berlin, Conn. | C. V. O. Co.'s High Grade Special. |
| Cooper's Glue Factory, Peter, 13 Burling Slip, N. Y. City. | Pure Bone Dust. |
| Dennis, George L., Stafford Springs, Conn. | Ground Bone. |
| Eldredge, T. H., 97 Water St., Norwich, Conn. | Eldredge's Special Fish and Potash tilizer,<br>Superphosphate. |
| Frisbie, L. T. Co., The, Hartford, Conn. | Frisbie's Fine Bone Meal. |
| James, Ernest L., Warrenville, Conn. | James' Bone Phosphate,<br>Ground Bone. |
| Joynt, John, Lucknow, Ontario. | Canada Hard Wood Ashes. |
| Kelsey, E. R., Short Beach, Conn. | Bone, Fish and Potash. |
| Listers' Agricultural Chemical Works, Newark, N. J. | Standard Pure Bone Superphospha Lime,<br>Corn and Potato Fertilizer,<br>Ammoniated Dissolved Bone,<br>Listers Potato Manure,<br>Bone Meal,<br>Animal Bone and Potash,<br>Special 10% Potato,<br>Celebrated Ground Bone,<br>Success Fertilizer. |
| MacCormack, William, Wolcott, Conn. | Mad River Strictly Pure Ground I |
| Manchester, E., & Sons, Station A., Winsted, Conn. | Manchester's Formula A. |
| Mapes F. & P. G. Co., The, 143 Liberty St., N. Y. City. | Potato Manure,<br>Tobacco Starter, Improved,<br>Manure, Wrapper Brand,<br>Fruit and Vine,<br>Economical Potato Manure,<br>Vegetable Manure, or Complete Ma for Light Soils,<br>Average Soil Complete Manure,<br>Tobacco Ash Constituents,<br>Corn Manure,<br>Top Dresser, Improved, Full Stren<br>Half<br>Complete Manure "A" Brand,<br>Dissolved Bone,<br>Cereal Brand,<br>Seeding Down Manure. |

| *Firm.* | *Brand of Fertilizer.* |
|---|---|
| National Fertilizer Co., Bridgeport, Conn. | Chittenden's Ammoniated Bone,<br>Market Garden,<br>Complete,<br>Formula "A",<br>Fish and Potash XXX,<br>Soluble Bone and Potash,<br>Fish and Potash,<br>Potato Phosphate,<br>Universal Phosphate,<br>Potato Special 3-5-10,<br>*Formula B,*<br>Complete Tobacco,<br>*High Grade Special Tobacco,*<br>Tobacco Starter,<br>Grower,<br>Dry Fish,<br>*Tobacco Special with Carbonate of Potash.* |
| New England Fertilizer Co., 43 North Market St., Boston, Mass. | New England Potato Fertilizer,<br>High Grade Potato Fertilizer,<br>Superphosphate,<br>Corn and Grain Fertilizer,<br>Perfect Tobacco Grower,<br>Ground Bone. |
| North Western Fertilizing Co., Chicago, Ill. | North Western Complete Manure,<br>10% Potato Fertilizer,<br>Fish, Bone and Potash,<br>Market Garden Phosphate,<br>Superphosphate,<br>10% Manure,<br>Empire Special Manure. |
| Ohio Farmers Fertilizer Co., Columbus, Ohio. | Potato and Tobacco Special. |
| Olds & Whipple, Hartford, Conn. | O. & W's. Complete Tobacco Fertilizer,<br>High Grade Potato Fertilizer,<br>Special Phosphate,<br>Home Mixture for Corn and Potatoes,<br>Home Mixture for Grass,<br>Vegetable Potash. |
| Parmenter & Polsey Fertilizer Co., Peabody, Mass. | Plymouth Rock,<br>Special Potato,<br>"P. & P." Potato,<br>"A. A." Brand,<br>Ground Bone,<br>Star Brand,<br>Muriate of Potash,<br>Nitrate of Soda |

| *Firm.* | *Brand of Fertilizer.* |
|---|---|
| Rogers & Hubbard Co., The, Middletown, Conn. | Hubbard's Fertilizer for Oats and Dressing, |
| | Grass and Grain Fertili |
| | Soluble Tobacco Manu |
| | Potato Manure, |
| | Corn and Ge |
| | Crops Manu |
| | Potato Phosphate, |
| | Complete Phosphate, |
| | Market Garden Phosph |
| | Pure Raw Knuckle Flour, |
| | Strictly Pure Fine Bor |
| Rogers Manufacturing Co., The, Rockfall, Conn. | All Round Fertilizer, |
| | Complete Potato and Vegetable, |
| | High Grade Corn and Onion, |
| | Soluble Tobacco, |
| | Oats and Top Dressir |
| | Fish and Potash, |
| | High Grade Grass and Grain, |
| | Soluble Tobacco and tato, |
| | Tobacco Starter, |
| | Grower, |
| | Pure Ground Bone, |
| | Knuckle Bone Flour. |
| Russia Cement Co., Gloucester, Mass. | Essex XXX Fish and Potash, |
| | Corn Fertilizer, |
| | Market Garden and Potato nure, |
| | A 1 Superphosphate, |
| | Complete Manure for Corn, and Grass, |
| | Complete Manure for Pot Roots and Vegetables, |
| | Tobacco Starter, |
| | Special Tobacco Manure, |
| | Dry Ground Fish, |
| | Grass and Top Dressing. |
| Sanderson Fertilizer & Chemical Co., New Haven, Conn. | Sanderson's Formula A., |
| | Potato Manure, |
| | Corn Superphosphate, |
| | Special with 10% Pota |
| | Formula B. for Tobac |
| | Fine Ground Fish, |
| | Bone, |
| | Atlantic Coast Bone, Fish and Pota |
| | Sanderson's Top Dressing Fertiliz |
| | Muriate of Potash, |
| | Nitrate of Soda, |
| | Sulphate of Potash. |
| Shay, C. M., Fertilizer Co., The, Groton, Conn. | Shay's Potato Manure, |
| | Corn Manure, |
| | Grass Fertilizer, |
| | Pure Ground Bone. |

| *Firm.* | *Brand of Fertilizer.* |
|---|---|
| Shoemaker, M. L., & Co., Philadelphia, Pa. | Swift-Sure Bone Meal,<br>Phosphate for General U:<br>Potatoes,<br>Truck, Co<br>and Onioı |
| Swift's Lowell Fertilizer Co., 44 North Market St., Boston. | Swift's Lowell Bone Fertilizer,<br>Animal Brand,<br>Potato Phosphate,<br>Manure,<br>Dissolved Bone and Pc<br>ash,<br>Empress Brand,<br>Market Garden Manu<br>Perfect Tobacco Grow<br>Ground Bone,<br>Superior Fertilizer,<br>Special Grass Mixture,<br>Vegetable Manure. |
| Wilcox Fertilizer Works, The, Mystic, Conn. | Wilcox's Potato, Onion and Vegetal<br>Manure,<br>Potato Fertilizer,<br>Complete Bone Superphc<br>phate,<br>High Grade Fish and Potasl<br>Fish and Potash,<br>Grass Fertilizer,<br>Nitrate of Soda,<br>Dry Ground Fish,<br>Pure Ground Bone,<br>Acid Phosphate,<br>Muriate of Potash. |
| Woodruff, S. D., & Sons, Orange, Conn. | Woodruff's Home Mixture. |

The analyses which follow are chiefly useful as a guide in making purchases for the next year. Most of them are of brands which are offered year after year in Connecticut and the analyses serve to show whether or not these brands are maintaining their original quality.

The larger part of the year's supply of fertilizers is shipped into the state just before planting time, much of it after river navigation is opened. Many brands are not in market till the middle of April. Obviously these trade conditions make it absolutely impossible for the station to sample and analyze the two hundred and eighty-eight brands of fertilizers sold in Connecticut and tabulate and publish the results in time to show the composition of all of them before they are bought and applied.

When new brands are offered, the station endeavors to analyze such brands at once and to distribute the report of the results as quickly and widely as possible. Farmers can aid greatly by calling the attention of the station promptly to new kinds of fertilizers which are offered for sale.

## SAMPLING AND COLLECTION OF FERTILIZERS.

During April, May and June, Mr. V. L. Churchill, the sampling agent of this station, visited ninety-four towns and villages in Connecticut to draw samples of commercial fertilizers for analysis. These places were distributed as follows:

| | |
|---|---|
| Litchfield County | 10 |
| Hartford County | 26 |
| Tolland County | 5 |
| Windham County | 10 |
| New London County | 11 |
| Middlesex County | 7 |
| New Haven County | 14 |
| Fairfield County | 11 |
| | 94 |

In these places five hundred and fifty-eight samples were taken, representing all but seven of the brands which have been entered for sale in this state.

The sampling agent could not find on sale Bowker Fertilizer Co.'s Tobacco Carbonates, Coe-Mortimer Co.'s Gold Brand Excelsior Guano, National Fertilizer Co.'s Tobacco Starter, Tobacco Grower and Formula B., Northwestern Fertilizing Co.'s Empire Special and Lister's Ammoniated Dissolved Bone. With the exception of the last named fertilizer, no samples of these brands were deposited by the manufacturers at the station. It was, therefore, impossible to make analyses of them.

With these exceptions, an analysis has been made of every brand of fertilizer which has been entered at the station for sale in Connecticut.

When several samples of a single brand are drawn in different parts of the state, the analysis is usually performed, not on any single sample, but on a mixture made of equal weights of all of the several samples. Thus, it is believed, the average composition of the goods is more fairly represented than by the analysis of single samples.

The station agent is instructed in every case to open at least three packages of each brand for sampling, and, if the number of packages is very large, to take a portion from every tenth one, by means of a sampling tube which withdraws a section or core diagonally through the entire length of the bag or barrel.

As a rule, the station will not analyze samples taken from dealer's stock of less than one ton, from stock which has lain over from last season, or from stock which is improperly stored, as in bags lying on wet ground, or exposed to the weather, etc.

The station desires the coöperation of farmers, farmers' clubs and granges in calling attention to new brands of fertilizers, and in securing samples of all goods offered for sale. *All samples must be drawn in strict accordance with the Station's Instructions for Sampling, and must also be properly certified.* A copy of these instructions and blank certificates will be sent on application.

A sample taken carelessly or incorrectly is quite certain to work injustice both to the seller and buyer. Accuracy of sampling is just as necessary as accuracy of analysis. The sampling is, in reality, a very important part of the analysis.

## ANALYSES OF FERTILIZERS.

During the year 559 samples of commercial fertilizers and manurial waste-products have been analyzed. A classified list of them is given below and the results of their examination are given in detail in the following pages.

Samples are analyzed as promply as possible in the order in which they are received. As soon as an analysis is completed, a copy of it is sent to the party who furnished the sample and also to the manufacturer, in order that there may be opportunity for correction or protest, before the results are published.

## DESCRIPTIONS AND ANALYSES OF FERTILIZERS.*

The samples referred to in the following pages were drawn by the station agent, unless the contrary is stated.

*The analyses of fertilizers included in this chapter have been made by Dr. Winton, chemist in charge, with the assistance of Messrs. Bailey, Kreider and Shanley and Miss Barber, station chemists, and of Mr. Lange. The results have been tabulated and discussed by the director.

The analyses were made by the methods adopted by the Association of Official Agricultural Chemists and the results are always expressed in percentages, or parts per hundred by weight, of the material examined.

Every percentage given has been determined by two separate analyses, usually made by two chemists working independently, and all calculations are also made in duplicate.

In order to avoid confusion, each sample, as it is received, is given a consecutive number, by which it is distinguished in the laboratory. As the numbers had become so large as to be somewhat unwieldy, the numbering was begun again at unity in 1900.

## CLASSIFICATION OF THE FERTILIZERS ANALYZED.

| | No. of Samples. |
|---|---|
| 1. *Containing nitrogen as the chief valuable ingredient.* | |
| Nitrate of soda | 14 |
| Dried blood | 2 |
| Cotton seed meal | 93 |
| Castor pomace | 7 |
| Linseed meal | 2 |
| 2. *Containing phosphoric acid as the chief valuable ingredient.* | |
| Acid phosphate | 10 |
| Burned bone | 1 |
| 3. *Containing potash as the chief valuable ingredient.* | |
| Carbonate of potash | 11 |
| Caustic potash | 2 |
| "Carbonate of potash" | 2 |
| High grade sulphate of potash | 3 |
| Double sulphate of potash | 7 |
| Muriate of potash | 12 |
| Kainit | 2 |
| 4. *Containing nitrogen and phosphoric acid.* | |
| Bone manures | 37 |
| Stag horn scrap | 1 |
| Slaughter-house tankage | 7 |
| Dry ground fish | 9 |
| Acidulated fish scrap | 1 |
| 5. *Mixed fertilizers.* | |
| Nitrogenous superphosphates | 112 |
| Special manures | 155 |
| Home mixed fertilizers | 11 |
| 6. *Miscellaneous fertilizers and manures.* | |
| "Vegetable Potash" | 1 |
| Cotton hull ashes | 21 |
| Wood ashes | 14 |
| Lime and lime-kiln ashes | 7 |
| Others, miscellaneous | 15 |
| Total | 550 |

## I. *RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.*

### NITRATE OF SODA OR SODIUM NITRATE.

Nitrate of Soda is mined in Chili and purified there before shipment. As offered in the Connecticut market it contains about 15.70 per cent. of nitrogen, equivalent to 95.3 per cent. of pure sodium nitrate.

Shipments differ somewhat in composition. The lowest percentage of nitrogen found in any sample this year is 15.00, equivalent to 91.1 per cent. of sodium nitrate.

Fourteen samples have been analyzed as follows:—

**16663** and **16377**. Sold by American Agricultural Chemical Co., New York. Sampled from stock of Connecticut School for Boys, Meriden.

**16606**. Sold by Parmenter & Polsey, Peabody, Mass. Sampled from stock of A. R. Holcomb, W. Suffield.

**16366**. Sold by American Agricultural Chemical Co., New York. Sampled from stock of J. G. Schwink, Meriden.

**16664**. Sold by Wilcox Fertilizer Works, Mystic. Sampled from stock of M. E. Thompson, Ellington.

**16114**. Sold by Swift's Lowell Fertilizer Co., Boston. From stock of Andrew Ure, Highwood.

**16388**. Sampled at factory of Wilcox Fertilizer Works, Mystic.

**16694**. Sold by Bowker Fertilizer Co., New York. Sampled from stock of Bowker's Branch, Hartford.

**16417**. Sold by Russia Cement Co., Gloucester, Mass. Sampled from stock of Spencer Bros., Suffield.

**16334**. Sampled from stock of S. D. Woodruff & Sons, Orange.

**16335**. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Sampled at factory.

**16829**. Sold by Coe-Mortimer Co., New York. Sampled from stock of J. P. Barstow, Norwich.

**16353**. Sold by Buffalo Fertilizer Co., Buffalo, New York. Sampled from stock of E. Manchester & Sons, Winsted.

ANALYSES OF NITRATE OF SODA.

| Station No. | 16663 | 16377 | 16606 | 16366 | 16664 | 16114 | 16388 | 16694 | 16417 | 16334 | 16335 | 16829 | 16353 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Percentage amounts of* | | | | | | | | | | | | | |
| Nitrogen found | 15.30 | 15.0 | 15.70 | 15.30 | 15.30 | 15.68 | 15.04 | 15.58 | 15.24 | 15.20 | 15.16 | 15.28 | 15.72 |
| Equivalent nitrate of soda | 92.9 | 91.1 | 95.3 | 92.9 | 92.9 | 95.2 | 91.3 | 94.6 | 92.5 | 92.3 | 92.0 | 92.7 | 95.4 |
| Nitrogen guaranteed | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.83 | 15.0 | 15.0 | .... | .... | 15.0 | 15.0 | 16.0 |
| Cost per ton | $47.76 | 47.76 | 52.00 | 52.00 | 52.50 | 55.00 | 53.00 | 55.00 | 55.00 | 55.00 | 55.00 | 56.00 | .... |
| Nitrogen costs cents per pound | 15.6 | 15.9 | 16.6 | 17.0 | 17.2 | 17.5 | 17.6 | 17.7 | 18.0 | 18.1 | 18.1 | 18.3 | .... |

Two complete analyses of nitrate of soda show the ingredients not commonly included in an analysis.

| | | |
|---|---|---|
| Station No. | 16366 | 16335 |
| *Percentage amounts of* | | |
| Water | 3.61 | 4.05 |
| Insoluble in water | 0.14 | 0.35 |
| Common salt, sodium chloride | 1.73 | 1.98 |
| Glauber's salt, sodium sulphate | 1.65 | 1.72 |
| Nitrate of soda | 92.87 | 91.90 |
| | 100.00 | 100.00 |

It appears that nitrate of soda contains, as accidental and unavoidable impurities, from one to two per cent. each of salt and Glauber's salt, with a little insoluble matter and a variable amount of moisture.

**The percentage of nitrogen in the thirteen samples ranges from 15.00 to 15.72 and averages 15.42. This is about two-tenths per cent. lower than last year.**

**The retail cost of nitrogen in this form has ranged from 15.6 to 18.3 cents per pound, the average being 17.3 cents, less than half a cent higher than in 1905.**

A sample, **18318**, bought for nitrate of soda by E. E. Burwell, New Haven, from the Swift's Lowell Fertilizer Co., of Boston, for $53.00 per ton, was found to be a mixture of sulphate of ammonia, nitrate of soda and dirt. It contained

| | | |
|---|---|---|
| Nitrogen as nitrate | 7.22 | per cent. |
| Nitrogen as ammonia | 7.00 | " |
| Matters insoluble in water | 16.15 | " |

The Swift's Lowell Fertilizer Co. write in reference to this mixture:

"We were completely out of nitrate of soda by the middle of April and we were obliged to pick it up wherever possible.

Many of these purchases were not tested by us for the reason that they would arrive to-day, and be shipped to-morrow.

We shipped Mr. Burwell's order from a lot bought through second hands and of which we have no record of test. We regret exceedingly to have this occur but were obliged to do the best we could during the rush season. We are taking up the matter with Mr. Burwell."

## DRIED BLOOD.

This is blood collected in slaughter houses which is cooked to thoroughly coagulate it, dried by pressure and artificial heat, and then ground. Prepared in this way it contains about 14 per cent. of nitrogen. Lower grades mixed with tankage and other material, and containing 10 to 12 per cent. of nitrogen are also on the market.

**16109.** Sold by Swift's Lowell Fertilizer Co., Boston. Stock of Andrew Ure, Highwood.

**16800.** Sold by Coe-Mortimer Co., New York. Stock of W. P. Holmes, Griswold.

ANALYSES OF DRIED BLOOD.

| Station No. | 16109 | 16800 |
|---|---|---|
| *Percentage amounts of* | | |
| *Nitrogen found* | *12.08* | *11.68* |
| Nitrogen guaranteed | 10.0 | .... |
| Cost per ton | $38.00 | 51.00 |
| **Nitrogen costs cents per pound** | **15.7** | **21.8** |

## COTTON SEED MEAL.

(ANALYSES ON PAGES 20 TO 23.)

This material is of two kinds, which are known in trade respectively as undecorticated and decorticated. In their manufacture cotton seed is first ginned to remove most of the fiber, then passed through a "linter" to take off the short fiber or lint remaining, then through machines which break and separate the larger part of the hulls. The hulled seed is ground and the oil expressed. The ground cake from the presses is used as a cattle feed and fertilizer. Formerly the hulls were burned for fuel in the oil factories and the resulting ashes, which contained from 20 to 30 per cent. of potash, were used in this state as a tobacco fertilizer.

The hulls have, however, come into extensive use as a cattle feed at the South, and now sell for this purpose at prices which forbid their use as a fuel. A larger proportion of them is left in the so-called "decorticated meal" now than ever before.

In view of the fact that more than $50,000 are yearly spent by tobacco growers alone for Cotton Seed Meal, the following

rules of the Interstate Cotton Seed Crushers' Association adopted at Atlanta, Ga., in May, 1906, are of importance.

"Sec. 2. Choice Cotton Seed Meal must be finely ground, perfectly sound and sweet in odor, yellow, free from excess of lint and hulls, and by analysis must contain at least 8 per cent. of ammonia. (6.59 per cent. nitrogen.)

Sec. 3. Extra Prime Cotton Seed Meal must be finely ground, of sweet odor, reasonably bright in color, yellow, not brown or reddish, and by analysis must contain at least 7½ per cent. of ammonia. (6.2 per cent. nitrogen.)

Sec. 4. Prime Cotton Seed Meal must be finely ground, of sweet odor, reasonably bright in color, and by analysis must contain at least 7 per cent. of ammonia. (5.77 per cent. nitrogen.)

Sec. 6. Cotton Seed Meal not coming up to contract grade shall be a good delivery if within one-half of one per cent. of the ammonia contents of the grade sold, or the sale sample, but the settlement price shall be reduced at the rate of one tenth of the contract price for each one per cent., and proportionately for the fractions, of deficiency in ammonia."

The meaning of the last section, as far as cotton seed meal as a fertilizer goes, is that the meal must be accepted if not more than 0.41 per cent. deficient in nitrogen, but the settlement price shall be reduced at the rate of one tenth of the contract price for each 0.82 of one per cent. of nitrogen deficiency of nitrogen. For instance if "Choice" cotton seed meal, selling at $32.00 per ton, is found to contain 6.20 per cent. of nitrogen instead of 6.61 as guaranteed, it must be accepted, but $30.40 per ton must be accepted by the seller in payment.

The following rule regarding sampling should also be noted by those who do this work for themselves or others:

"Rule 20. Meal. Two ounces or more from a sack shall constitute a sample of meal, and must be drawn so as to fairly represent the entire contents of the bag. Twenty samples from each carload, or fifty sacks from each 100 tons, if not shipped in car lots, shall be sufficient to represent a shipment. Separate samples of meal should be well wrapped in heavy paper, sealed and labeled, so as to identify them and the shipment they represent. Samples of meal, if of approximately the same grade and quality, need not be kept separate, but may be commingled, in which case they must be placed in a metal mailing or sample box and carefully marked, showing the number of samples taken, as well as car number and mark."

In the table, pages 20 to 23, are analyses of 91 samples of cotton seed meal from stock bought chiefly if not wholly for use as fertilizer.

There has been no difference in the composition of the meal according to the month in which it was shipped, this year, such as was noticed in 1905.

The average percentages of phosphoric acid and potash in cotton seed meal are 3.15 and 1.90 respectively, which are valued together at $4.42 per ton. To determine the cost of nitrogen, the above figure is subtracted from the ton price and the remainder, after multiplying by 100 to reduce it to cents, is divided by the number of pounds of nitrogen in a ton of meal.

Thus if a sample of meal contains 6.94 per cent. of nitrogen (which is equivalent to 138.8 pounds in the ton) and costs $27.50 per ton, 27.50 — 4.42 = 23.08. And 2,308 divided by 138.8 = 16.6, which is the cost of nitrogen per pound in cents.

**The percentage of nitrogen ranges from 5.62 to 8.78. The average percentage of nitrogen is 6.60, being 0.3 per cent. lower than last year.**

**The cost of nitrogen ranges from 15.7 to 24.1 cents per pound, the average cost being 20.6 cents, 4.1 cents higher than in 1905.**

Cotton seed meal within a few years has passed from one of the cheapest to one of the most expensive forms of quickly available nitrogen. Its cost has gone up from $25.00 to $31.50 and the percentage of nitrogen has steadily decreased, as appears from the following figures:

| | Average per cent. of nitrogen. | Average cost of nitrogen, cents per pound. |
|---|---|---|
| 1900 .......... | 7.26 | 14.3 |
| 1901 .......... | 7.24 | 14.9 |
| 1902 .......... | 7.08 | 16.0 |
| 1903 .......... | 7.09 | 16.0 |
| 1904 .......... | 7.13 | 16.5 |
| 1905 .......... | 6.93 | 16.4 |
| 1906 .......... | 6.60 | 20.6 |

The fact that grinders find it unprofitable to remove the hulls from the meal as completely as formerly, before expressing the oil, accounts for the lower percentage of nitrogen found.

### *Guaranties.*

The common guaranty of nitrogen has been 6.50 per cent. Thirty-eight samples, more than a third of the whole number, have fallen below this figure.

The station has frequently been asked to state what rebate should be given where meal fails to meet the guaranty. The station has no authority or desire to prescribe adjustments of price between buyer and seller, but has suggested the following example as perhaps indicating a fair method of adjustment.

A meal, costing $32.00 per ton, guaranteed 6.5 per cent. of nitrogen contains only 6.24.

As stated on page 18 the average valuation of phosphoric acid and potash in a ton of meal is $4.42; 32.00—4.42 = $27.58, which we may call the price of the nitrogen in it. The meal is guaranteed to have 6.50 per cent. of nitrogen, or 130 pounds per ton; $27.58 ÷ 130 = 21.2, the cost of a pound of nitrogen in the meal if as guaranteed. But instead of 130 pounds it contains in fact only 6.24 × 20 = 124.8 pounds, a deficiency of 5.2 pounds, which at 21.2 cents per pound equals $1.10, the rebate to be allowed to the buyer.

The following analyses are not tabulated with the others as it is not quite certain what lots they represent:—

In sample **16272** the station found, as the mean of three closely agreeing determinations, 6.37 per cent. of nitrogen.

The jobber reported that his chemist found "over 6.50 per cent." The Connecticut dealer was asked to draw a second sample, which he did, and in this sample, **16467**, the station found 6.62 per cent. and a New York analyst, to whom the sample was referred, 6.67 per cent. One or the other of the samples, if not both, obviously did not fairly represent the car lot from which they were drawn.

## CASTOR POMACE.

(Analyses on page 24.)

This is the ground residue of castor beans from which castor-oil has been expressed or extracted. The nitrogen which it contains is readily available to plants, but the pomace is extremely poisonous to animals, which often eat it greedily when the opportunity offers.

Seven samples have been analyzed this year, as follows:—

**16263.** Sold by Olds & Whipple, Hartford. Sampled and sent by P. S. Brewer, Silver Lane.

**16264.** Baker's Pomace. Sold by Olds & Whipple, Hartford. Sampled and sent by E. P. Brewer, Silver Lane.

## ANALYSES OF COTTON SEED MEAL.

| Station No. | Dealer. | Purchased, Sampled or Sent by | Per cent. of Nitrogen. | Cost per ton. | Nitrogen costs cents per pound. |
|---|---|---|---|---|---|
| 16241 | Olds & Whipple, Hartford | E. P. Brewer, Silver Lane | 8.78 | $32.00 | 15.7 |
| 16242 | " " " | R. A. McJunkin, Hartford | 8.78 | 32.00 | 15.7 |
| 16243 | " " " | P. D. Kibbe, Hartford | 8.78 | 32.00 | 15.7 |
| 16567 | Arthur Sikes, Suffield | G. A. Harmon, Suffield, and others | 7.02 | 30.25 | 18.4 |
| 16570 | Humphreys, Godwin & Co., Memphis, The Loomis Bros. Co., Granby | L. C. Spring, Granby | 7.41 | 31.75 | 18.4 |
| 16601 | Humphreys, Godwin & Co., Memphis, The Loomis Bros. Co., Granby | A. H. Griffin, Granby | 7.30 | 31.50 | 18.5 |
| 16571 | Geo. B. Robinson, Suffield | E. N. Austin, Suffield | 6.60 | 29.00 | 18.6 |
| 16232 | Humphreys, Godwin & Co., Spencer Bros., Suffield | Bissell, Graves Co., Suffield | 7.42 | 32.25 | 18.8 |
| 16248 | " " " " " " | " " " | 7.40 | 32.25 | 18.8 |
| 16302 | Olds & Whipple, Hartford | M. B. Thompson, Hartford | 6.06 | 27.50 | 19.0 |
| 16391 | Planters Cotton Oil Co., Augusta, Ga. | Ackley, Hatch & Marsh, New Milford | 6.22 | 28.00 | 19.0 |
| 16303 | Olds & Whipple, Hartford | R. C. Hyde, Windsor | 6.03 | 27.50 | 19.1 |
| 16518 | Humphreys, Godwin & Co., Spencer Bros., Suffield | J. O. *Haskins, Suffield* | *7.03* | *31.50* | *19.3* |
| 16514 | Am. Cotton Oil Co., N. Y., Spencer Bros., Suffield | Howard Woodworth, Suffield | 6.71 | 30.50 | 19.4 |
| 16483 | Arthur Sikes, Suffield | C. A. Prout and others, Suffield | 6.83 | 31.00 | 19.5 |
| 16480 | " " " | E. S. Seymour, Suffield | 7.20 | 32.50 | 19.5 |
| 16568 | " " " | D. I. King and others, Suffield | 6.80 | 31.00 | 19.5 |
| 16823 | Humphreys, Godwin & Co., The Loomis Bros. Co., Suffield | B. G. Holcomb, Southwick, Mass. | 6.68 | 30.50 | 19.5 |
| 16424 | Humphreys, Godwin & Co., Spencer Bros., Suffield | The Bissell, Graves Co., Suffield | 7.10 | 32.25 | 19.6 |
| 16538 | " " " Dixie Brand | Chas. H. Phelps, Melrose | 6.77 | 31.00 | 19.6 |
| 16661 | Arthur Sikes, Suffield | John Sullivan, Suffield | 6.77 | 31.00 | 19.6 |
| 16516 | Am. Cotton Oil Co., N. Y., Spencer Bros., Suffield | M. Doughney, Windsor Locks | 6.89 | 31.50 | 19.7 |
| 16365 | *Arthur Sikes, Suffield* | *Emil Weber and others, Suffield* | 6.70 | 31.00 | 19.8 |
| 16587 | Humphreys, Godwin & Co., The Loomis Bros. Co., Granby | The Loomis Bros. Co., Granby | 6.66 | 30.75 | 19.8 |

### ANALYSES OF COTTON SEED MEAL.—*Continued.*

| Station No. | Dealer. | Purchased, Sampled or Sent by | Per cent. of Nitrogen. | Cost per ton. | Nitrogen costs cents per pound. |
|---|---|---|---|---|---|
| 16487 | Humphreys, Godwin & Co., D. J. Ahern, E. Windsor Hill | Wm. H. Daly, Warehouse Point | 6.82 | $31.50 | 19.9 |
| 16531 | Arthur Sikes, Suffield | E. S Seymour, Windsor Locks | 7.04 | 32.50 | 19.9 |
| 16569 | " " " | John Sullivan, Suffield | 6.68 | 31.00 | 19.9 |
| 16485 | V. E. Moore | Jeremiah Lynch, Thompsonville | 6.77 | 31.50 | 20.0 |
| 16515 | Humphreys, Godwin & Co., Spencer Bros., Suffield | B. L. Root, Suffield | 6.76 | 31.50 | 20.0 |
| 16659 | Arthur Sikes, Suffield | T. F. Devine and others, Suffield | 6.66 | 31.00 | 20.0 |
| 16182 | Hunter Bros. Milling Co., St. Louis, H. A. Bugbee, Willimantic | C. T. Remington, Suffield | 6.72 | 31.50 | 20.1 |
| 16415 | Am. Cotton Oil Co., Spencer Bros., Suffield | Station agent | 6.74 | 31.50 | 20.1 |
| 16448 | Daniels Mill Co., Hartford | Poquonock Agr'l Co., Poquonock | 6.69 | 31.25 | 20.1 |
| 16660 | Arthur Sikes, Suffield | John Sullivan, Suffield | 6.61 | 31.00 | 20.1 |
| 16517 | Humphreys, Godwin & Co., Spencer Bros., Suffield | T. J. Noone, Suffield | 6.27 | 29.75 | 20.2 |
| 16799 | S. D. Viets, Springfield, Mass. | C. J. Holcomb, West Suffield | 6.32 | 30.00 | 20.2 |
| 16183 | Hunter Bros. Milling Co., H. A. Bugbee, Willimantic | C. T. Remington, Suffield | 6.66 | 31.50 | 20.3 |
| 16482 | Arthur Sikes, Suffield | W. E. Ford and others, Suffield | 6.90 | 32.50 | 20.3 |
| 16249 | Am. Cotton Oil Co., Spencer Bros., Suffield | Christopher Michel, Suffield | 6.89 | 32.50 | 20.4 |
| 16765 | Arthur Sikes, Suffield | John Sullivan, Suffield | 6.52 | 31.00 | 20.4 |
| 16318 | Olds & Whipple, Hartford | T. K. Marcy, Poquonock | 6.70 | 32.00 | 20.6 |
| 16481 | Arthur Sikes, Suffield | D. A. Woodworth, Suffield | 6.82 | 32.50 | 20.6 |
| 16764 | " " " | J. H. Wetherell, Suffield, and others | 6.46 | 31.00 | 20.6 |
| 16166 | Hunter Bros. Milling Co., R. L. Forsyth, Granby | R. L. Forsyth, Granby | 6.66 | 32.00 | 20.7 |
| 16185 | J. T. & R. S. Wells, Memphis | Latham & Chittenden, Granby | 6.18 | 30.00 | 20.7 |
| 16227 | Am. Cotton Oil Co., J. E. Soper & Co., Boston | L. C. Brainard, Thompsonville | 6.54 | 31.50 | 20.7 |
| 16464 | Arthur Sikes, Suffield | I. D. Woodworth, Suffield | 6.78 | 32.50 | 20.7 |
| 16484 | " " " | Margaret Tobin, Windsor Locks | 6.79 | 32.50 | 20.7 |

## Analyses of Cotton Seed Meal.—*Continued.*

| No. | Dealer. | Purchased, Sampled or Sent by | Per cent. of Nitrogen. | Cost per ton. | Nitrogen costs cents per pound. |
|---|---|---|---|---|---|
| 202 | *Georgia Cotton Oil Co., Augusta, Ga.*, S. D. Viets & Co., Springfield, Mass. | James Price, Warehouse Point | 6.52 | $31.50 | 20.8 |
| 204 | Am. Cotton Oil Co., Spencer Bros., Suffield | Oscar I. Hazard, Suffield | 6.76 | 32.50 | 20.8 |
| 416 | J. Lindsey Wells Co., Memphis, Spencer Bros., Suffield | Station agent | 6.50 | 31.50 | 20.8 |
| 208 | Am. Cotton Oil Co., Spencer Bros., Suffield | B. L. Root, Suffield | 6.72 | 32.50 | 20.9 |
| 337 | J. E. Soper & Co., Boston, W. F. Fletcher, Southwick, Mass. | John B. Cannon, Granby | 6.60 | 32.00 | 20.9 |
| 564 | Humphreys, Godwin & Co. | Broad Brook Lumber and Coal Co. | 6.48 | 31.50 | 20.9 |
| 566 | Arthur Sikes, Suffield | G. A. Harmon, Suffield | 6.72 | 32.50 | 20.9 |
| 184 | S. D. Viets & Co., Springfield, Mass. | O. B. Phillips, Suffield | 6.33 | 31.00 | 21.0 |
| 203 | Am. Cotton Oil Co., Spencer Bros., Suffield | B. L. Root, Suffield | 6.69 | 32.50 | 21.0 |
| 247 | Chapin & Co., Boston, Spencer Bros., Suffield | A. A. Brown, Suffield | 6.70 | 32.50 | 21.0 |
| 572 | Arthur Sikes, Suffield | E. N. Austin, Suffield | 6.68 | 32.50 | 21.0 |
| 106 | J. E. Soper & Co., Boston, Spencer Bros., Suffield | J. P. Spencer, Suffield | 6.17 | 30.50 | 21.1 |
| 246 | J. T. & R. S. Wells, Memphis, S. D. Viets, Springfield, Mass. | C. F. Whittemore, West Suffield | 6.41 | 31.50 | 21.1 |
| 565 | Humphreys, Godwin & Co. | Broad Brook Lumber and Coal Co. | 6.40 | 31.50 | 21.2 |
| 165 | Magnolia, C. M. Cox Co., Boston, S. D. Viets, Springfield, Mass. | J. A. DuBon, Poquonock | 6.04 | 30.00 | 21.2 |
| 234 | Chapin & Co., Boston, Spencer Bros., Suffield | James Olram, Suffield | 6.62 | 32.50 | 21.2 |
| 195 | J. L. Wells Co., Memphis, Tenn. | Henry Hemingway, Suffield | 6.24 | 31.00 | 21.3 |
| 226 | J. E. Soper & Co., Boston, H. K. Brainard, Thompsonville | L. C. Brainard, Thompsonville | 6.35 | 31.50 | 21.3 |
| 096 | Spencer Bros., Suffield | D. L. Brockett, Suffield | 6.06 | 30.40 | 21.4 |
| 267 | Chapin & Co., Boston, Spencer Bros., Suffield | B. L. Root, Suffield | 6.57 | 32.50 | 21.4 |

ANALYSES OF COTTON SEED MEAL.—*Concluded.*

| Station No. | Dealer. | Purchased, Sampled or Sent by | Per cent. of Nitrogen. | Cost per ton. | Nitrogen costs cents per pound. |
|---|---|---|---|---|---|
| 16313 | Arthur Sikes, Suffield | G. W. Phelps and others, Suffield | 6.32 | $31.50 | 21.4 |
| 16311 | " " " | K. McCabe, Windsor Locks | 6.52 | 32.50 | *21.5 |
| 16155 | Chapin & Co., Boston, Spencer Bros., Suffield | Edmund Halliday, Suffield | 6.04 | 30 50 | 21.6 |
| 16101 | Spencer Bros., Suffield | L. F. Woodworth, Suffield | 6.25 | 31.50 | 21.7 |
| 16205 | Chapin & Co., Boston, Spencer Bros., Suffield | C. D. Burbank, Suffield | 6.24 | 31.50 | 21.7 |
| 16314 | Am. Cotton Oil Co., Latham & Chittenden, Granby | Indian Head Plantations, Granby | 6.34 | 32.00 | 21.8 |
| 16167 | Chapin & Co., Boston, Spencer Bros., Suffield | G. A. Peckham, Suffield | 6.18 | 31.50 | 21.9 |
| 16196 | J. E. Soper & Co., Boston, H. K. Brainard, Thompsonville | Seth Alden, Thompsonville | 6.32 | 32.25 | 22.0 |
| 16312 | Arthur Sikes, Suffield | O. E. Pitcher and others, Suffield | 6.15 | 31.50 | 22.0 |
| 16206 | Humphreys, Godwin & Co., Spencer Bros., Suffield | Bissell, Graves Co., Suffield | 6.31 | 32.25 | 22.1 |
| 16266 | " " " " " " | " " " " | 6.28 | 32.25 | 22.2 |
| 16539 | R. L. Forsyth, Granby | H. G. Viets, Granby | 5.76 | 30.00 | 22.2 |
| 16235 | H. A. Bugbee, Willimantic | Walter H. Pierce, Suffield | 6.02 | 31.50 | 22.5 |
| 16489 | Humphreys, Godwin & Co., Frank M. Thompson | B. W. Lord, Warehouse Point | 6.14 | 32.00 | 22.5 |
| 16336 | J. E. Soper & Co., Boston, C. H. Dexter & Sons, Windsor Locks | J. M. Bahr, Warehouse Point | 6.32 | 33.00 | 22.6 |
| 16186 | Planters Cotton Oil Co., Augusta, Ga. | Meech & Stoddard, Middletown | 6.30 | 33.00 | 22.7 |
| 16233 | Humphreys, Godwin & Co., Spencer Bros., Suffield | Bissell, Graves Co., Suffield | 6.12 | 32.25 | 22.7 |
| 16488 | Humphreys, Godwin & Co., F. M. Thompson, Warehouse Point | W. W. Thompson, Warehouse Point | 6.07 | 32.00 | 22.7 |
| 16207 | Humphreys, Godwin & Co., Spencer Bros., Suffield | Bissell, Graves Co., Suffield | 6.10 | 32.25 | 22.8 |
| 16209 | Chapin & Co., Spencer Bros., Suffield | H. C. Cone, Suffield | 6.15 | 32.50 | 22.8 |
| 16310 | Arthur Sikes, Suffield | S. F. Brown and others, Windsor | 6.11 | 32.50 | 23.0 |
| 16309 | " " " | D. I. King and W. C. Smith, Suffield | 5.94 | 32.50 | 23.6 |
| 16103 | Planters Cotton Oil Co., Augusta, Ga. | Meech & Stoddard, Middletown | 5.62 | 31.50 | 24.1 |

**16532.** *Sold by Olds & Whipple, Hartford. Sampled and* sent by E. S. Seymour, Windsor Locks.

**16603.** Sold by Bowker Fertilizer Co., New York. Sampled from stock of Newell St. John, Simsbury, and H. K. Brainard, Thompsonville.

**16413.** H. J. Baker & Bro's. Pomace, sold by Olds & Whipple, Hartford. Sampled from stock of Spencer Bros., Suffield.

**16604.** Sold by American Agricultural Chemical Co., New York. Sampled from stock of F. S. Bidwell & Co., Windsor Locks.

**16414.** Sold by American Agricultural Chemical Co. Sampled from stock of E. N. Austin, Suffield.

ANALYSES OF CASTOR POMACE.

| Station No. | 16263 | 16264 | 16532 | 16603 | 16413 | 16604 | 16414 |
|---|---|---|---|---|---|---|---|
| *Percentage amounts of* | | | | | | | |
| Nitrogen found | 6.13 | 5.03 | 4.93 | 4.84 | 5.06 | 4.42 | 4.40 |
| Nitrogen guaranteed | 5.00 | 5.00 | 4.75 | 4.12 | 5.00 | 4.53 | 4.12 |
| Cost per ton | $24.00 | 23.50 | 23.00 | 23.00 | 24.00 | 23.00 | 23.00 |
| **Nitrogen costs cents per pound** | 17.5 | 20.8 | 20.8 | 21.1 | 21.2 | 23.1 | 23.3 |

The percentages of phosphoric acid and potash in castor pomace average 1.95 and 0.98 respectively. The cost of nitrogen is determined in each case by deducting $2.54—the valuation of the phosphoric acid and potash—from the ton price, and dividing the remainder by the number of pounds of nitrogen in a ton of the pomace.

**The cost of nitrogen in castor pomace has ranged from 17.5 to 23.3 cents per pound, the average being 21.1 cents, half a cent per pound more than in cotton seed meal.**

## LINSEED MEAL.

In the Poquonock experiments carried on some years ago by this station, linseed meal proved to be a good form of organic nitrogen for tobacco.

The present high price of cotton seed meal has therefore led to some inquiry for linseed meal as a substitute. Two samples have been examined, as follows:

**16156**, No. 1, and **16157**, No. 2. Both sold by Spencer Bros., Suffield. Sampled and sent by the Bissell, Graves Co., Suffield.

ANALYSES OF LINSEED MEAL.

| Station No. | 16156 | 16157 |
|---|---|---|
| *Percentage amounts of* | | |
| Nitrogen found | 5.85 | 5.70 |
| Nitrogen guaranteed | 5.92 | 5.92 |
| Cost per ton | $29.50 | 29.50 |
| **Nitrogen costs cents per pound** | **22.5** | **23.0** |

Linseed meal, besides nitrogen, contains about 2.15 per cent. of phosphoric acid and 1.50 per cent. of potash. These are valued, in calculating the cost of nitrogen, at 4 and 5 cents per pound respectively.

**The cost of nitrogen per pound has been two to three cents higher in linseed than in cotton seed.**

## II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

### DISSOLVED ROCK PHOSPHATE OR ACID ROCK.

This material, made by treating various mineral phosphates with oil of vitriol, has been practically the only form in which water-soluble phosphoric acid could be bought during the past year.

The following ten analyses show the quality of the dissolved phosphate sold this year in this state:—

**16809.** Sold by Coe-Mortimer Co., New York. Sampled from stock of W. P. Holmes, Griswold.

**16367.** Sold by American Agricultural Chemical Co., New York. Sampled from stock of J. G. Schwink, Meriden.

**16810.** Sold by Bowker Fertilizer Co., New York. Sampled from stock of H. K. Brainard, Thompsonville.

**16408.** Sold by American Agricultural Chemical Co., New York. Sampled from stock of E. N. Austin, Suffield.

**16389.** Sold by Wilcox Fertilizer Works. Sampled at factory.

**16338.** Sampled from stock of S. D. Woodruff & Sons, Orange.

**16350.** Sold by Buffalo Fertilizer Co., Buffalo. Sampled and sent by E. Manchester & Sons, Winsted.

## ANALYSES OF DISSOLVED ROCK PHOSPHATE.

| Station No. | 16809 | 16367 | 16810 | 16408 | 16389 | 16338 | 16350 | 16811 | 16110 | 16375 |
|---|---|---|---|---|---|---|---|---|---|---|
| *Percentage amounts of* | | | | | | | | | | |
| Water-soluble phosphoric acid | 8.06 | 7.73 | 12.10 | 10.98 | 12.32 | 12.38 | 11.57 | 7.49 | 11.85 | 12.26 |
| Citrate-soluble phosphoric acid | 3.91 | 6.82 | 2.91 | 3.35 | 3.19 | 3.17 | 0.99 | 4.78 | 2.29 | 1.89 |
| *Citrate-insoluble phosphoric acid* | *2.38* | *2.50* | *1.08* | *2.02* | *2.55* | *1.07* | *2.16* | *2.30* | *1.62* | *2.40* |
| Total phosphoric acid found | 14.35 | 17.05 | 16.09 | 16.35 | 18.06 | 16.62 | 14.72 | 14.57 | 15.76 | 16.55 |
| Total phosphoric acid guaranteed | **1.40** | **15.0** | **16.00** | **15.00** | .... | .... | .... | .... | **14.0** | **15.0** |
| Sum of water-soluble and citrate-soluble phosphoric acid found | 11.97 | 14.55 | 15.01 | 14.33 | 15.51 | 15.55 | 12.56 | 12.27 | 14.14 | 14.15 |
| "Available phosphoric acid" guaranteed | **11.00** | **14.00** | **14.00** | **14.00** | **14.00** | .... | **14.00** | **14.00** | .... | **14.00** |
| **Cost per ton** | $11.00 | 14.00 | 14.00 | 14.00 | 16.00 | .... | .... | .... | .... | .... |
| **"Available phosphoric acid" costs cents per pound** | **4.2** | **4.5** | **4.5** | **4.6** | **4.8** | .... | .... | .... | .... | .... |

**16811.** Sold by Buffalo Fertilizer Co., Buffalo. Sampled from stock of E. Manchester & Sons, Winsted.

**16110.** Sold by Swift's Lowell Fertilizer Co., Boston. Sampled from stock of Andrew Ure, Highwood.

**16375.** Sold by National Fertilizer Co., Bridgeport. Sampled from stock of Connecticut School for Boys, Meriden.

Sample **16350** was drawn by Mr. Manchester early in April. The analysis was unsatisfactory to the seller, who stated that analyses from the pile or lot from which Mr. Manchester's goods came showed 16 per cent. of total phosphoric acid instead of fourteen and a fraction.

The station agent therefore drew another sample from Mr. Manchester's stock a month later, which is represented by No. **16811** in the table. The composition of the two samples is alike, except that the soluble phosphoric acid has "reverted" or "gone back" in the bags during the month's storage.

**It appears that water-soluble and citrate-soluble phosphoric acid, taken together, have cost this year at retail about 4.6 cents per pound. In mixed car lots it has cost considerably less.**

It needs to be remembered that "available phosphoric acid" is purely a trade name for the sum of the water-soluble and citrate-soluble phosphoric acid and has no necessary connection with the availability of the phosphoric acid to crops. Water-soluble phosphoric acid is comparatively readily available to plants. When applied to the soil it quickly becomes insoluble in water, but exists for a time at least in forms which are easily decomposed and absorbed by the action of the plant roots. This is not by any means equally true of all forms of citrate-soluble phosphoric acid. Some of them are, probably, about as quickly and perfectly "available," in the agricultural sense, as water-soluble phosphates, while others are, by comparison, quite "unavailable" and there is no means, at present known, for determining this difference in the laboratory.

The method of citrate extraction was devised for, and is strictly applicable only to, the determination of that part of the phosphoric acid in a plain superphosphate ("acid phosphate," or dissolved rock phosphate) which had been at first dissolved by sulphuric acid but by further chemical reactions has become insoluble in water. Such a case is represented by the two

samples **16350** and **16811** cited above. It was formerly called "backgone" or "reverted" phosphoric acid.

But when this method is applied to such mixed fertilizers as are now in the trade, containing bone, tankage and sometimes iron and aluminum phosphates, citrate-solution dissolves much phosphate which has not been made more soluble by the manufacture than it was originally, and some of which cannot be considered as readily "available" to crops.

### BURNED BONE.

A sample of this material, **16271**, a residue from some manufacturing process, contained 0.58 per cent. of nitrogen and 40.42 per cent. of phosphoric acid. Experience indicates that the phosphate of bone ash and bone char is but very slowly available to plants. Bone ash makes a very excellent basis for the manufacture of acid phosphate or dissolved bone. It will, however, seldom pay to attempt to treat phosphates with acid without a factory equipment.

## *III. RAW MATERIALS OF HIGH GRADE CONTAINING POTASH.*

### CARBONATE OF POTASH.

(Analyses on page 29.)

Commercial carbonate of potash is much used at present as a source of potash for tobacco lands. It comes in casks, holding about one thousand pounds, and is a white granular solid which gathers moisture quickly if exposed to damp air and becomes noticeably moist and sticky. It must therefore be kept in tight, closed packages until needed for use. The lumps which are found in it are easily screened out and pulverized. No difficulty has been found in making, storing, or applying a mixture of cotton seed meal and carbonate of potash. If the mixture were kept over for a season, especially if it got damp, there is little doubt that it would cake badly in bags and liberate some nitrogen in form of ammonia from the meal. This tendency to absorb water makes the matter of proper sampling more than usually difficult.

The best way to sample is to bore into the middle of the cask with a long auger, quickly withdraw a sample, putting it at once

## Analyses of Carbonate of Potash.

| Station No. | 16533 | 16785 | 16426 | 16781 | 16782 | 16783 | 16784 | 16446 | 16644 | 16645 | 16786 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Percentage amounts of* | | | | | | | | | | | |
| Potash found | 64.92 | 66.78 | 66.57 | 65.25 | 64.76 | 64.96 | 64.86 | 66.42 | 65.00 | 62.71 | 59.96 |
| Equivalent carbonate | 95.30 | 98.03 | 97.72 | 95.79 | 95.07 | 95.36 | 95.21 | 97.50 | 95.42 | 92.06 | 88.02 |
| Carbonate guaranteed | 96.0 | 98.0 | 96.8 | 98.0 | 98.0 | 98.0 | 98.0 | 96.0 | 96.0 | 96.00 | 98.00 |
| Water | 1.65 | 1.45 | 1.27 | 3.60 | 4.40 | 4.15 | 4.23 | 1.35 | 1.00 | 5.85 | 11.48 |
| Other matters, by difference | 3.05 | 0.52 | 1.01 | 0.61 | 0.53 | 0.49 | 0.56 | 1.15 | 3.58 | 2.10 | 0.50 |
| Cost per ton | $87.80* | 92.50 | 93.00 | 92.50 | 92.50 | 92.50 | 92.50 | 95.00 | 95.00 | 95.00 | 92.50 |
| **Potash costs cents per pound** | 6.8 | 6.9 | 7.0 | 7.1 | 7.1 | 7.1 | 7.1 | 7.2 | 7.3 | 7.6 | 7.7 |

* Delivered.

into a can with a tight cover and later closing the hole in the cask with a bung cork.

The following eleven analyses show the composition of the carbonate sold in this state:—

**16533.** Sold by A. Klipstein & Co., New York. Sampled and sent by P. P. Hickey, Burnside.

**16426.** Sold by Olds & Whipple, Hartford. Sampled and sent by E. J. Wells, East Windsor Hill.

Each of the samples, **16785**, sampled by Patrick Quinn; **16781**, sampled by O. E. Pitcher; **16782**, sampled by Allan Woodworth; **16783**, sampled by Howard Woodworth; **16784**, sampled by J. E. Phelps, and **16786**, sampled by Charles Wright, all of Suffield, was taken from a different cask in a two carload lot bought of Innis, Speiden & Co., New York, and sent to the station by J. E. Phelps, Suffield.

**16446.** Sold by A. Klipstein & Co., New York. Sampled and sent by Poquonock Agricultural Co.

**16644.** Sold by A. Klipstein & Co., New York. Sampled and sent by G. A. Douglass, Thompsonville.

**16645.** Sold by Bowker Fertilizer Co., Boston, Mass. Sampled and sent by Charles T. Remington, Suffield.

It will be seen that samples **16533**, **16644** and **16645** contain over two per cent. of other salts, chiefly, as appears from full analyses in the previous report, 1905, page 36, chloride and sulphate of potash. These amounts are, however, quite too small to affect in any way the value as a tobacco fertilizer. The percentage of potash in the other samples is higher or lower according to the amount of water in them. Thus **16786**, which has only 59.96 per cent. of potash, has an unusually high per cent of water, 11.48.

In some cases when weights have been carefully made it has been found that casks showing low percentages of potash weighed considerably more than the invoice called for because the carbonate had absorbed water during shipment. Thus while the *percentage* of potash was below guaranty the total number of pounds of potash delivered was fully what the guaranty called for.

**The price of water-soluble potash, in high grade carbonate, has ranged from 6.8 cents to 7.7 cents per pound, the average being 7.2 cents.**

## CAUSTIC POTASH.

"Soap-boiler's potash" has been sometimes used as a fertilizer for tobacco, being dissolved in water and spread with a sprinkling cart. The difficulties and dangers coming from the very corrosive action of the potash and of the solution have, however, led to its abandonment. Two samples of caustic potash, sent by the superintendent of the Connecticut Hospital for the Insane, had the following composition:

ANALYSES OF CAUSTIC POTASH.

| | 16098 | 16097 |
|---|---|---|
| *Percentage amounts of* | | |
| Potash ($K_2O$) soluble in water.. | 63.29 | 63.70 |
| Chlorine ...................... | 1.06 | 1.08 |
| Water ........................ | 15.26 | 14.05 |
| Total potassium hydrate......... | 75.32 | 75.80 |
| Cost per ton.................... | $108.90 | 110.00 |
| **Potash costs cents per pound..** | **8.6** | **8.6** |

## "CARBONATE OF POTASH."

**16892** and **17092** are samples of "Carbonate of Potash." Sold by the Swift's Lowell Fertilizer Co. to W. G. and F. Comstock, East Hartford. The analyses indicate that this is some form of vegetable ashes, perhaps of beet "chips" or beet molasses. If so the small percentage of nitrogen is probably in form of cyanides and of no agricultural value.

ANALYSES OF "CARBONATE OF POTASH."

| | 16892 | 17092 |
|---|---|---|
| *Percentage amounts of* | | |
| Nitrogen ...................... | 0.24 | 0.24 |
| Phosphoric acid ................ | 1.09 | 0.49 |
| Potash calculated as muriate..... | 2.48 | 2.40 |
| " " as sulphate .... | 2.06 | 1.95 |
| " " as carbonate .. | 20.28 | 19.21 |
| Chlorine ...................... | 1.87 | 1.81 |
| Sulphuric acid ................. | 1.75 | 1.66 |
| Cost per ton ................... | $37.00 | 37.00 |
| **Potash costs cents per pound..** | **7.9** | **8.5** |

## HIGH GRADE SULPHATE OF POTASH.

(ANALYSES ON PAGES 34 AND 35.)

This chemical should contain about 90 per cent. of pure potassium sulphate (sulphate of potash), or about 40 per cent.

of potassium oxide, a per cent. less than is contained in muriate, and should be nearly free from chlorine.

The three samples, whose analyses are given, are all of good quality.

**The cost of potash per pound in form of high grade sulphate has been about five cents.**

## DOUBLE SULPHATE OF POTASH AND MAGNESIA.

(ANALYSIS ON PAGES 34 AND 35.)

This material is usually sold as "sulphate of potash" or "manure salt," on a guaranty of "48-50 per cent. sulphate," which is equivalent to 25.9-27.0 per cent. of potassium oxide. Besides some 46-50 per cent. of potassium sulphate, it contains over 30 per cent. of magnesium sulphate, chlorine equivalent to 3 per cent. of common salt, a little sodium and calcium sulphates, with varying quantities of moisture.

Of the seven samples analyzed three were of inferior quality, containing considerable matter insoluble in water.

**The cost of potash per pound, in double sulphate of potash of good quality, has been between five and six cents.**

## MURIATE OF POTASH

(ANALYSIS ON PAGES 34 AND 35.)

Commercial muriate of potash contains about 80 per cent. of muriate of potash (potassium chloride), 15 per cent. or more of common salt (sodium chloride) and 4 per cent. or more of water.

Of the twelve samples analyzed one was of rather inferior quality. The others were well above the guaranty.

**The price per pound of potash in muriate has been about four and one-half cents.**

## KAINIT.

(ANALYSIS ON PAGES 34 AND 35.)

Kainit is less uniform in composition than the other potash salts. It contains from 11 to 15 per cent. of potash, more than that quantity of soda, and rather less magnesia. These "bases" are combined with chlorine and sulphuric acid. Unless "cal-

cined," it contains more water than either the sulphate or the muriate of potash. It is usually sold on a guaranty of 12 to 15 per cent. of potash, or 23 to 25 per cent. "sulphate of potash." It is not properly called, or claimed to be, a sulphate of potash, since it contains more than enough chlorine to combine with all the potash present, and there are sound reasons for believing that its potash exists chiefly as muriate and, to a much less extent, as sulphate. Its action and effects are unquestionably those of a muriate rather than of a sulphate.

**The cost per pound of potash in the single sample was four and one-half cents.**

The very favorable action of kainit on grass-land, which is frequently observed, is doubtless due in part to the other salts in it, particularly common salt, and recalls the practice, formerly in vogue, of "salting" meadows.

## SLAUGHTER-HOUSE TANKAGE.

(Analyses on page 36.)

After boiling or steaming meat scrap, bone and other slaughter-house waste, fat rises to the surface and is removed, the soup is run off and the settlings are dried and sold as tankage. Tankage has a very variable composition. In general, it contains more nitrogen and less phosphoric acid than bone.

Below are analyses of seven samples of this material from the Connecticut market.

**16340.** Made by Connecticut Fat Rendering & Fertilizer Corporation, New Haven. Sampled at the factory.

**16712.** Sold by Olds & Whipple, Hartford. Sampled and sent by P. P. Hickey, Burnside.

**16107** and **16339.** Sampled from stock bought by S. D. Woodruff & Sons, Orange.

**16351.** Made by Buffalo Fertilizer Co. Sampled and sent by E. Manchester & Sons, Winsted.

**16108.** Made by Swift's Lowell Fertilizer Co., Boston. Sampled from stock of Andrew Ure, Highwood.

**16376.** Sold by American Agricultural Chemical Co., New York. Sampled by station agent from stock of Connecticut School for Boys, Meriden.

POTASH SALTS. PERCENTAGE COMPOSITION AND

| Station No. | Drawn from stock in possession of | Sampled and sent by |
|---|---|---|
| | *High Grade Sulphate of Potash:* | |
| 16419 | E. N. Austin, Suffield, from Am. Ag'l Chemical Co., N. Y. | Station agent |
| 16423 | Spencer Bros., Suffield, from Russia Cement Co., Gloucester, Mass. | " " |
| 16354 | E. Manchester & Sons, Winsted | E. Manchester & Sons |
| | *Double Sulphate of Potash:* | |
| 16371 | J. G. Schwink, Meriden, from Am. Ag'l Chemical Co., N. Y. | Station agent |
| 16536 | L. P. Bissell, Suffield, from Am. Ag'l Chemical Co., N. Y. | L. P. Bissell |
| 16418 | E. N. Austin, Suffield, from Am. Ag'l Chemical Co., N. Y. | Station agent |
| 16346 | Sanderson Fertilizer and Chemical Co., New Haven | " " |
| 16737 | James Lasbury, Broad Brook, from National Fertilizer Co., Bridgeport | C. W. Covell, E. Windsor Hill |
| 16422 | Spencer Bros., Suffield, from Russia Cement Co., Gloucester, Mass. | Station agent |
| 16374 | Conn. School for Boys, Meriden, from Am. Ag'l Chemical Co., N. Y. | " " |
| | *Muriate of Potash:* | |
| 16368 | J. G. Schwink, Meriden, from Am. Ag'l Chemical Co., N. Y. | Station agent |
| 16680 | A. R. Holcomb & H. Ude, Suffield, from Parmenter & Polsey, Peabody, Mass. | " " |
| 16387 | Wilcox Fertilizer Works, Mystic, Conn. | " " |
| 16344 | S. D. Woodruff & Sons, Orange | " " |
| 16681 | M. E. Thompson, Ellington, from Wilcox Fertilizer Works, Mystic | " " |
| 16345 | Sanderson Fertilizer and Chemical Co., New Haven | " " |
| 16812 | Bowker's Branch, Hartford, from Bowker Fertilizer Co., N. Y. | " " |
| 16421 | Spencer Bros., Suffield, from Am. Ag'l Chemical Co., N. Y. | " " |
| 16420 | E. N. Austin, Suffield, from Am. Ag'l Chemical Co., N. Y. | " " |
| 16352 | E. Manchester & Sons, Winsted | E. Manchester & Sons |
| 16113 | Andrew Ure, Highwood, from Swift's Lowell Fertz. Co., Boston | Station agent |
| 16372 | Conn. School for Boys, Meriden, from Am. Ag'l Chemical Co., N. Y. | " " |
| | *Kainit:* | |
| 16370 | J. G. Schwink, Meriden, from Am. Ag'l Chemical Co., N. Y. | Station agent |
| 16373 | Conn. School for Boys, Meriden, from Am. Ag'l Chemical Co., N. Y. | " " |

## Cost per Pound of Potash.

| Station No. | Potash soluble in water, found. | Potash guaranteed. | Cost per ton. | Potash costs cents per pound. |
|---|---|---|---|---|
| 16419 | 50.59 | 48.0 | $50.00 | 4.9 |
| 16423 | 48.67 | ---- | 52.00 | 5.3 |
| 16354 | 50.43 | 50.0 | ---- | --- |
| 16371 | 25.72 | 26.0 | 28.00 | 5.4 |
| 16536 | 25.18 | ---- | 28.50 | 5.7 |
| 16418 | 25.99 | 28.0 | 30.00 | 5.8 |
| 16346 | 24.50 | 25.0 | 30.00 | 6.1 |
| 16737 | 23.72 | 25.9 | 29.00 | 6.1 |
| 16422 | 22.05 | ---- | 30.00 | 6.8 |
| 16374 | 26.84 | 25.0 | ---- | --- |
| 16368 | 51.82 | 50.0 | 42.00 | 4.1 |
| 16680 | 55.46 | 50.0 | 46.00 | 4.1 |
| 16387 | 51.87 | 50.0 | 44.00 | 4.2 |
| 16344 | 51.17 | ---- | 44.00 | 4.3 |
| 16681 | 51.17 | 50.0 | 44.50 | 4.3 |
| 16345 | 51.22 | 50.0 | 45.00 | 4.4 |
| 16812 | 50.76 | 50.0 | 45.00 | 4.4 |
| 16421 | 52.01 | 50.0 | 49.00 | 4.7 |
| 16420 | 47.18 | 50.0 | 45.00 | 4.8 |
| 16352 | 51.52 | 50.0 | ---- | --- |
| 16113 | 49.20 | 50.0 | ---- | --- |
| 16372 | 51.02 | 50.0 | ---- | --- |
| 16370 | 13.28 | 12.0 | 12.00 | 4.5 |
| 16373 | 12.82 | 12.0 | ---- | --- |

| Station No. | 16340 | 16712 | 16107 | 16339 | 16351 | 16108 | 16376 |
|---|---|---|---|---|---|---|---|
| MECHANICAL ANALYSIS. | | | | | | | |
| Finer than $\frac{1}{50}$ inch | 36 | 60 | 58 | 58 | 42 | 53 | 52 |
| Coarser than $\frac{1}{50}$ inch | 64 | 40 | 42 | 42 | 58 | 47 | 48 |
| | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| CHEMICAL ANALYSIS. *Percentage amounts of* | | | | | | | |
| Nitrogen | 4.40 | 9.57 | 7.85 | 7.50 | 5.58 | 5.58 | 5.53 |
| Phosphoric acid | 17.04 | 6.27 | 13.65 | 13.60 | 12.00 | 16.23 | 15.82 |
| Cost per ton | $20.00 | 37.00 | .... | .... | .... | .... | .... |
| Valuation per ton | 24.47 | 35.13 | 34.73 | 33.59 | 25.06 | 28.93 | 28.39 |

Tankage is usually quoted at wholesale, by the ton, with a guaranty expressing the amounts of ammonia and bone phosphate; as "6 and 30." The equivalent nitrogen is calculated by dividing the ammonia figure by 1.2; the equivalent phosphoric acid by dividing the bone-phosphate figure by 2.18. Thus "6 and 30" is equivalent to nitrogen, 5 per cent., phosphoric acid 13.8 per cent.

## DRY GROUND FISH.

This is a by-product from the manufacture of fish oil, a process which removes from the fish little that is of value as a fertilizer.

The fresh fish are cooked by steam, pressed to remove the oil, and dried either in the air or, more commonly, in the large factories, by steam. The scrap is sometimes sprinkled with diluted oil of vitriol, to check putrefaction, whereby the bones are softened and to some extent dissolved. Nine samples have been examined, as follows:—

**16491.** Made by Wilcox Fertilizer Works, Mystic. Sampled and sent by Wm. H. Daly, Warehouse Point.

**16341.** Made by Wilcox Fertilizer Works, Mystic. Sampled from stock of Olds & Whipple, Hartford.

**16308.** Made by Wilcox Fertilizer Works, Mystic. Sampled and sent by W. H. Filley, Windsor.

**16411.** Made by American Agricultural Chemical Co., New York. Sampled from stock of E. N. Austin, Suffield.

**16407.** Sold by Bowker Fertilizer Co., New York. Sampled from stock of Seth Viets, West Suffield.

**16409.** Made by Russia Cement Co., Gloucester. Sampled from stock of Spencer Bros., Suffield.

## PERCENTAGE COMPOSITION AND VALUATION OF DRY FISH.

| | *Wilcox Fertilizer Works.* | | | Am. Ag. Chem. Co. | Bowker. | Russia Cement Co. | National Fertilizer Co. | Am. Ag. Chem. Co. | Sanderson. |
|---|---|---|---|---|---|---|---|---|---|
| Station No. | **16491** | **16341** | **16308** | **16411** | **16407** | **16409** | **16808** | **16410** | **16807** |
| *Percentage amounts of—* | | | | | | | | | |
| Nitrogen as ammonia | 0.34 | 0.37 | 0.28 | 0.22 | 0.14 | 0.10 | 0.29 | 0.16 | 0.39 |
| " organic | 8.89 | 8.81 | 8.74 | 7.81 | 8.46 | 6.83 | 8.01 | 7.37 | 7.53 |
| Total nitrogen found | 9.23 | 9.18 | 9.02 | 8.03 | 8.60 | 6.93 | 8.30 | 7.53 | 7.92 |
| " " guaranteed | **8.5** | **8.5** | **8.5** | **8.2** | **8.2** | **8.0** | **8.2** | **8.2** | **8.0** |
| Water-soluble phosphoric acid | 0.61 | 0.70 | 1.06 | 0.77 | 1.06 | 0.70 | 1.15 | 0.83 | 0.90 |
| Citrate-soluble " " | 4.70 | 4.75 | 5.16 | 4.61 | 4.35 | 11.39 | 4.66 | 5.39 | 4.78 |
| Citrate-insoluble " " | 1.29 | 1.18 | 0.78 | 1.22 | 1.34 | 5.56 | 1.35 | 1.42 | 0.97 |
| Total phosphoric acid *found* | 6.60 | 6.63 | 7.00 | 6.60 | 6.75 | 17.65 | 7.16 | 7.64 | 6.65 |
| " " " guaranteed | **6.0** | **6.0** | **6.0** | **7.0** | **6.0** | **11.0** | .... | **7.0** | **6.0** |
| Cost per ton | $37.00 | 37.00 | 37.00 | 35.00 | 38.00 | 39.00 | 37.50 | 35.00 | 38.00 |
| Valuation per ton | $38.91 | 38.80 | 38.71 | 34.54 | 36.76 | 37.58 | 35.97 | 33.46 | 34.25 |
| Percentage difference between cost and valuation | ***4.9** | ***4.7** | ***4.4** | **1.3** | **3.4** | **3.8** | **4.3** | **4.6** | **10.9** |

* Valuation exceeds cost.

**16808.** Sold by National Fertilizer Co., Bridgeport. Sampled from stock of W. E. Burbank, Suffield, and G. A. Williams, Silver Lane.

**16410.** Made by American Agricultural Chemical Co., New York. Sampled from stock of E. N. Austin, Suffield.

**16807.** Sold by Sanderson Fertilizer & Chemical Co., New Haven. Sampled from stock of manufacturer and of J. O. Griswold, Glastonbury.

Of the nine samples, three fail to meet the manufacturers' guaranty, Nos. 16411, 16409 and 16410.

In three of the samples the valuation exceeds cost, in most of the others valuation and cost are nearly alike.

The higher percentage of phosphoric acid and correspondingly lower percentage of nitrogen in the Russia Cement Co.'s fish appear to be due to the larger amount of fish bone contained in it.

**Cost and valuation differ but very little, indicating that dry fish has been one of the cheapest sources of available nitrogen and phosphoric acid.**

### ACIDULATED FISH SCRAP.

A single sample, **16088**, sent by E. R. Kelsey, Branford, had the following percentage composition:

| | |
|---|---|
| Water | 40.15 |
| Total nitrogen | 5.17 |
| Water- and citrate-soluble phosphoric acid... | 3.61 |
| Acid-soluble phosphoric acid | 0.53 |
| Total phosphoric acid | 4.14 |

## IV. RAW MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

### BONE MANURES.

The terms "Bone Dust," "Ground Bone," "Bone Meal" and "Bone" applied to fertilizers, sometimes signify material made from dry, clean and pure bones; in other cases these terms refer to the result of crushing fresh or moist bones which have been thrown out either raw or after cooking, with more or less meat, tendon and grease, and—if taken from garbage or ash heaps—with ashes or soil adhering; again they denote mixtures of bone, blood, meat and other slaughter-house refuse which

have been cooked in steam tanks to recover grease, and are then dried and sometimes sold as "tankage"; or finally, they apply to bone from which a large share of the nitrogenous substance has been extracted in the glue manufacture. When they are in the same state of mechanical subdivision, the nitrogen of all these varieties of bone probably has about the same fertilizing value.

### Valuation of Fertilizers in General.

The table of analyses of bone manures contains a column headed "Valuation per ton."

The valuation of a fertilizer, as practiced at this station, consists in calculating the retail trade-value or cash-cost at freight centers (in raw material of good quality) of an amount of nitrogen, phosphoric acid and potash equal to that contained in one ton of the fertilizer.

The trade value per pound of these ingredients is reckoned from the current market prices of the standard articles which furnish them to commerce. The valuation of a fertilizer does not show either its fair price or agricultural value. Nor should it be inferred that the ingredients of a given mixture always have the market value represented by the valuation.

The valuation, properly understood and used, does, however, furnish a rational basis for comparing the commercial values of fertilizer mixtures.

*The consumer, in estimating the reasonable price to pay for high-grade* fertilizers, should add to the trade-value of the above-named ingredients *a suitable margin for the expenses of manufacture and sale, and for the* convenience or other advantage incidental to their use.

### Trade-Values of Fertilizer Elements for 1906*

The average trade-values or retail costs in market, per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid and potash in raw materials and chemicals, as found in New England, New York and New Jersey markets during 1905, were as follows:

| | Cents per pound |
|---|---|
| Nitrogen in nitrates | 16½ |
| in ammonia salts | 17½ |
| Organic nitrogen in dry and fine-ground fish, meat and blood, and in mixed fertilizers | 18½ |
| in fine† bone and tankage | 18 |
| in coarse† bone and tankage | 13 |

* Adopted at a conference of representatives of the Connecticut, Maine, Massachusetts, New Jersey, Rhode Island and Vermont stations held in March, 1906.

† In this report "fine," as applied to bone and tankage, signifies smaller than 1/50 inch; and "coarse," larger than 1/50 inch.

| | | Cents per pound. |
|---|---|---|
| Phosphoric acid, | water-soluble | 4½ |
| | citrate-soluble* | 4 |
| | of fine† ground bone and tankage | 4 |
| | of coarse† bone and tankage | 3 |
| | of cotton-seed meal, castor pomace, and ashes | 4 |
| | *of mixed fertilizers, if insoluble in ammonium* citrate* | 2 |
| Potash as high-grade sulphate in forms free from muriate (or chlorides) | | 5 |
| | as muriate | 4¼ |
| | as carbonate | 8 |

The foregoing are, as nearly as can be estimated, the prices at which, during the six months preceding March last, the respective ingredients were retailed for cash, in our large markets, in those raw materials which are the regular source of supply. The valuations obtained by use of the above figures will be found to correspond fairly with the average retail prices, at the large markets, of standard raw materials, such as the following:

| | |
|---|---|
| Sulphate of ammonia, | Carbonate of potash, |
| Nitrate of soda, | Sulphate of potash, |
| *Dried blood,* | *Plain superphosphate,* |
| Azotin, | Dry ground fish, |
| Ammonite, | Bone and tankage, |
| Muriate of potash, | Ground South Carolina rock. |

### Valuation of Bone and Tankage.

To obtain the valuation of ground bone the sample is sifted into two grades, that finer than 1/50 inch, "fine," and that coarser than 1/50 inch, "coarse."

The nitrogen value of each grade is separately computed by multiplying the pounds of nitrogen per ton by the per cent. of each grade, multiplying one-tenth of that product by the trade value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade thus obtained, together with the values of each grade of phosphoric acid, similarly computed, the total is the valuation of the sample.

### 1. *Bone Manures Sampled by the Station agent.*

In the table on pages 42 and 43 are tabulated analyses of twenty-five samples.

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* Dissolved from 2 grams of the fertilizer, previously extracted with pure water, by 100 cc. neutral solution of ammonium citrate, sp. gr. 1.09, in thirty minutes, at 65° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" phosphoric acid.

† See note on previous page.

## GUARANTIES.

Eight of the samples drawn by the agent contain less nitrogen or phosphoric acid than is guaranteed, but in most cases when the percentage of one ingredient is below guaranty, that of the other is considerably above it, so that it may fairly be said that a commercial equivalent has been returned for the deficiency of one ingredient. Four brands, however, do not furnish an amount of plant food fully equivalent to what they are claimed to furnish.

These four brands are:—

16620. Bohl's Self-Recommending Fertilizer. Phosphoric acid found, 21.98, guaranteed, 24.1.

16805. Armour's Bone Meal. Phosphoric acid found, 22.77, guaranteed, 24.0.

16801. Coe-Mortimer's XXX Ground Bone. Nitrogen found, 2.18, guaranteed, 2.5.

16635. Buffalo Fertilizer Co.'s Ground Bone. Phosphoric acid found, 20.57, guaranteed, 23.0.

### COST AND VALUATION.

The price printed in full-face in the column showing cost per ton is the one used in calculating the percentage difference.*

The average cost of the 25 samples drawn by the station is $29.80 and the average valuation $27.08, a fairly satisfactory agreement.

### 2. *Sampled by Purchasers and Others.*

In the table above referred to are analyses of ten samples drawn by others than the station agent.

Two samples of Bone, **17880** and **17881**, sent by O. G. Beard, Shelton, were stated to be from the Sanderson Fertilizer Co., New Haven, and had apparently heated and caked in the bags. Their analyses are as follows:

| | 17880 | 17881 |
|---|---|---|
| *Mechanical analysis* | | |
| Fine | 52 | .... |
| Coarse | 48 | .... |
| | 100 | |
| *Nitrogen* | 2.75 | 2.88 |
| Phosphoric acid | 25.01 | .... |
| Valuation per ton | $26.19 | |
| Cost per ton | 29.00 | |

* Percentage difference shows the percentage excess of the cost price over the average retail cost, at freight centers, of the nitrogen and phosphoric acid contained in the fertilizer.

PERCENTAGE COMPOSITION AND

| Station No. | Name or Brand. | Manufacturer. |
|---|---|---|
| | *Sampled by Station Agent.* | |
| 6620* | Self-Recommending Fertilizer | Valentine Bohl, Waterbury |
| 6623 | Swift-Sure Bone Meal | M. L. Shoemaker & Co., Phila., |
| 6634 | Cooper's Bone Dust | Peter Cooper's Glue Factory, N. |
| 6802 | Lister's Bone Meal | Lister Fertilizer Works, Newark. |
| 6626 | Fine Knuckle Bone Flour | Rogers Manufacturing Co., Rock |
| 6804 | Fine Ground Bone | Rogers Manufacturing Co., Rocl |
| 6633 | Frisbie's Fine Bone Meal | L. T. Frisbie Co., Hartford |
| 6624 | *Shay's Ground Bone* | *C. M. Shay Fertilizer Co., Groto* |
| 6636 | Bowker's XX Ground Bone | Bowker Fertilizer Co., New Yorl |
| 6638 | Berkshire Ground Bone | Berkshire Fertilizer Co., Bridgep |
| 6630 | New England Ground Bone | New England Fertilizer Co., Bos |
| 6631 | Mad River Strictly Pure Ground Bone | William McCormack, Wolcott |
| 6622 | Swift's Ground Bone | Swift's Lowell Fertilizer Co., Bo |
| 6625 | Sanderson's Fine Ground Bone | Sanderson Fertilizer and Chemic New Haven |
| 6637 | Fresh Ground Bone | Bowker Fertilizer Co., New Yor |
| 6629 | Pure Ground Bone | Parmenter & Polsey, Peabody, M |
| 6621 | Wilcox's Pure Ground Bone | Wilcox Fertilizer Works, Mystic |
| 6803 | Dennis' Ground Bone | G. L. Dennis, Stafford Springs |
| 6639 | Fine Ground Bone | Am. Agricultural Chemical Co., |
| 6627 | Hubbard's Strictly Pure Fine Bone | Rogers & Hubbard Co., Middlet |
| 6628 | Hubbard's Raw Knuckle Bone Flour | Rogers & Hubbard Co., Middlet |
| 6635* | Buffalo Ground Bone | Buffalo Fertilizer Co., Buffalo, N |
| 6805* | Armour's Bone Meal | Armour Fertilizer Works, Baltim |
| 6801* | XXX Ground Bone | The Coe-Mortimer Co., New Yo |
| 6632 | Lister's Celebrated Ground Bone | Lister Agric. Chemical Works, N N. J. |
| | *Sampled by purchasers and others.* | *Manufacturer or Deal r.* |
| 465 | Degelatinized Bone | National Fertilizer Co., Bridgepo |
| 447 | Pure Fine Ground Bone | The Rogers Manufacturing Co., R |
| 305 | Peter Cooper's Pure Bone Dust | Peter Cooper's Glue Factory, N. |
| 551 | Pure Fine Ground Bone | The Rogers Manufacturing Co., R |
| 646 | Peter Cooper's Bone | Peter Cooper's Glue Factory, N. |
| 817 | James' Ground Bone | E. L. James, Warrenville |
| 306 | Bone Fertilizer | Unknown |
| 816 | Bone Fertilizer | W. M. Davidge & Co., New Yor |
| 200 | Bone | Buffalo Fertilizer Co., Buffalo, N |
| [illegible] | [illegible] | [illegible] |

## Valuation of Bone Manures.

| Dealer. | Dealer's cash price per ton. | Valuation per ton. | Percentage difference between cost and valuation. | Chemical Analysis. Nitrogen. Found. | Chemical Analysis. Nitrogen. Guaranteed. | Chemical Analysis. Phosphoric acid. Found. | Chemical Analysis. Phosphoric acid. Guaranteed. | Mechanical Analysis. Finer than 1-50 inch. | Mechanical Analysis. Coarser than 1-50 inch. |
|---|---|---|---|---|---|---|---|---|---|
| cturer | $26.00 | $30.00 | 13.3* | 3.96 | 3.7 | 21.98 | 24.6 | 78 | 22 |
| olf, Guilford | 33.00 | 35.06 | 4.4* | 5.34 | 4.1 | 24.11 | 20.0 | 66 | 34 |
| Whipple, Hartford | 34.00 | | | | | | | | |
| | 33.50 | | | | | | | | |
| Brainard, Thompsonville | 25.00 | 25.90 | 3.5* | 1.56 | 0.9 | 29.13 | 26.0 | 59 | 41 |
| artin, Wallingford | 27.00 | 27.78 | 2.9* | 2.72 | 2.7 | 26.38 | 23.0 | 61 | 39 |
| Sikes, Suffield | 31.00 | 30.08 | 3.1 | 4.00 | 3.8 | 25.39 | 24.0 | 49 | 51 |
| cturer | 30.00 | 28.79 | 4.2 | 3.24 | 2.5 | 24.68 | 22.0 | 68 | 32 |
| White, Rockville | 28.00 | 26.76 | 4.6 | 4.40 | 3.3 | 19.69 | 18.0 | 42 | 58 |
| cturer | 30.00 | 28.55 | 5.1 | 2.44 | 2.0 | 28.80 | 25.0 | 60 | 40 |
| r's Branch, Hartford | 25.00 | 23.76 | 5.2 | 1.94 | 1.0 | 26.06 | 25.0 | 43 | 57 |
| iss & Templeton, Water- | 31.00 | 28.79 | 7.7 | 4.83 | 2.5 | 19.61 | 20.0 | 51 | 49 |
| twater, Plantsville | 32.00 | 29.34 | 9.0 | 2.88 | 2.5 | 27.94 | 22.0 | 60 | 40 |
| cturer | 30.00 | 27.23 | 10.2 | 4.34 | 3.0 | 21.79 | 20.0 | 33 | 67 |
| arstow, Norwich | 32.00 | 27.09 | 10.8 | 2.50 | 2.5 | 26.95 | 23.0 | 56 | 44 |
| Bros., Granby | 28.00 | | | | | | | | |
| | 30.00 | | | | | | | | |
| acturer | 30.00 | 27.02 | 11.0 | 3.35 | 2.5 | 23.53 | 20.0 | 52 | 48 |
| r's Branch, Hartford | 28.00 | 24.88 | 12.6 | 2.65 | 2.5 | 24.35 | 22.0 | 45 | 55 |
| T. Hill, Suffield | 30.00 | 26.61 | 12.7 | 2.36 | 2.5 | 26.58 | 23.0 | 59 | 41 |
| acturer | 29.00 | 25.42 | 14.1 | 3.04 | 2.5 | 22.64 | 23.0 | 52 | 48 |
| acturer | 28.00 | 24.49 | 14.4 | 4.06 | 2.5 | 21.02 | 20.0 | 16 | 84 |
| nd Bros., South Norwalk | 34.00 | 27.77 | 17.0 | 3.20 | 2.5 | 25.27 | 22.0 | 52 | 48 |
| Cashen, Meriden | 31.00 | | | | | | | | |
| | 32.50 | | | | | | | | |
| Page & Co., Naugatuck | 35.00 | 28.94 | 20.9 | 2.35 | 2.9 | 28.09 | 22.0 | 75 | 2 |
| Andrews, Wallingford | 36.00 | 30.56 | 21.1 | 3.96 | 3.5 | 25.10 | 24.5 | 58 | 4 |
| Bidwell & Co., Windsor | 38.00 | | | | | | | | |
| ts | 37.00 | | | | | | | | |
| & Lynes, Norwalk | 30.00 | 24.45 | 22.7 | 2.86 | 2.5 | 20.57 | 25.0 | 67 | 3 |
| r & Hardin, Glastonbury | | | | | | | | | |
| Tucker, Vernon | 30.00 | 24.19 | 24.0 | 2.48 | 2.5 | 22.77 | 24.0 | 58 | 4 |
| Burdick, Westbrook | 31.00 | 24.71 | 25.5 | 2.18 | 2.5 | 26.17 | 25.0 | 45 | 5 |
| ngton Lumber Co., South-on | 26.00 | 18.04 | 44.1 | 2.82 | 2.5 | 12.90 | 12.0 | 55 | 4 |
| Wilcoxson, Stratford | 26.00 | | | | | | | | |
| *pled or sent by* | | | | | | | | | |
| Woodworth, Suffield | 21.00 | 25.53 | 17.7* | 1.80 | ---- | 27.76 | 27.5 | 57 | 4 |
| B. Parker, Poquonock | 26.00 | 28.85 | 9.9* | 0.96 | 1.2 | 31.74 | 30.0 | 100 | |
| Plant, Branford | 24.00 | 26.17 | 8.3* | 1.92 | 0.9 | 28.77 | 26.7 | 51 | 4 |
| w Kingsbury, Rockville | 30.00 | 31.39 | 4.4* | 1.72 | 1.2 | 31.50 | 30.0 | 100 | |
| Douglass, Thompsonville | 25.00 | 25.16 | 0.6* | 1.56 | 0.9 | 28.72 | 26.7 | 53 | 4 |
| facturer | 29.00 | 23.61 | 22.8 | 4.06 | ---- | 21.06 | ---- | 5 | 9 |
| City Nursery Co., New ven | 20.00 | 15.63 | 28.0 | 1.80 | ---- | 12.73 | --- | ---- | -- |
| Thomson, West Hartford | 22.00 | 13.47 | 63.3 | 1.66 | ---- | 12.55 | ---- | 39 | 6 |
| rd H. Barnes, New Haven | ---- | 25.43 | ---- | 2.57 | ---- | 23.69 | ---- | 62 | [illegible] |
| | | | | 1.54 | ---- | 26.67 | --- | ---- | -- |

## STAG-HORN SCRAP.

**18286.** Sent by Landers, Frary and Clark, New Britain, is a manufacturing by-product, containing 4.86 per cent. of nitrogen and 22.62 per cent. of phosphoric acid. It is rather coarse, only 20 per cent. passing holes $\frac{1}{50}$ inch in diameter, but it contains as much phosphoric acid as the clean "bone-meal" of the market and considerably more nitrogen and its "valuation" calculated in the same way as for bone is $28.09 per ton.

## NITROGENOUS SUPERPHOSPHATES AND GUANOS.

Here are included those mixed fertilizers containing nitrogen, phosphoric acid and, in most cases, potash, which are not designed by their manufacturers for use on any special crop. "Special Manures" are noticed further on.

### 1. *Samples Drawn by the Station Agent.*

In the table of analyses, pages 50-65, are given analyses of one hundred and five samples belonging to this class, arranged according to the percentage difference between cost and valuation.

### *Analyses requiring Special Notice.*

The manufacturer of Sanderson's Special with 10 per cent. Potash, sample No. **16577**, pages 58 and 59, objected that this analysis did not fairly represent the brand, which contained fully 10 per cent. of potash, and asked that another sample be drawn and examined.

This was done and the second analysis, **16665**, given on pages 56 and 57, shows 9.64 per cent. of potash.

The manufacturer of Coe-Mortimer's Long Islander Market Garden Special, **16727**, and Red Brand Excelsior Guano, **16728**, advised the Station that the analyses of these two brands were far from what they should be. The Station agent endeavored, after receiving this notice, to find other lots of these goods in the state but was unsuccessful.

The following analysis of Great Eastern General Fertilizer, **16688**, should have been included in the table of analyes at the place indicated on page 60. The analysis was made on a

mixture of two samples, one drawn by station agent from stock of J. H. Elliott, Campville, the other from T. E. Greene, Plainfield.

No. **16862** is a sample of a "Special Formula" sent without further particulars by J. N. Lasbury, Broad Brook.

| | 16688 | 16862 |
|---|---|---|
| *Percentage amounts of* | | |
| Nitrogen as nitrates | 0.08 | .... |
| " organic | 1.06 | 4.30 |
| " total | 1.14 | 4.30 |
| Phosphoric acid, water-soluble | 6.62 | 0.48 |
| " " citrate-soluble | 2.11 | 7.79 |
| " " citrate-insoluble | 2.17 | 2.05 |
| " " *total* | *10.90* | *10.32* |
| Potash calculated as muriate | 3.97 | 0.44 |
| " " " sulphate | .... | 7.68 |
| " " " carbonate | .... | 1.90 |
| " total | 3.97 | 10.02 |
| Chlorine | .... | 0.33 |
| Sulphuric acid | .... | 6.53 |
| Valuation per ton | $16.07 | 34.48 |
| Cost per ton | $27.00 | .... |
| Cost exceeds valuation | 68.0 | .... |

GUARANTIES.

**Of the one hundred and five analyses of nitrogenous superphosphates given in the table, which were sampled by the station agent, twenty-five, or about one-fourth of the total number, failed to meet the manufacturers' guaranties. Four were deficient in nitrogen alone, six in citrate-soluble phosphoric acid and eight in potash. Eight were deficient in respect of two ingredients and one in respect of all three. In most cases the deficiency is slight and accompanied with a considerable excess of another ingredient, so that it may be fairly said that a fair commercial equivalent has been returned for the deficiency of one ingredient.**

**Eight brands however are so deficient that they not only fail to meet the letter of the guaranty but also its spirit, in that they do not furnish an amount of plant food equivalent to what they are claimed to furnish. This shortage ranges from $0.39 to $7.57, the latter amount being nearly one-fifth of the cost price.**

**These eight brands are the following:—**

**16668. Parmenter & Polsey's A. A. Brand. Nitrogen found 3.51 per cent., guaranteed 4.1. Potash found 7.17, guaranteed 8.0.**

**16727. Coe-Mortimer's Long Islander Market Garden Special, Nitrogen found 3.00 per cent., guaranteed 3.4. Potash found 5.69, guaranteed 6.0.**

**16728. Coe-Mortimer's Red Brand Excelsior Guano.** Nitrogen found 2.76 per cent., guaranteed 3.3. Potash found 5.26, guaranteed 6.0.

**16793. Coe-Mortimer's Fish and Potash.** Citrate-soluble phosphoric acid found 5.82, guaranteed 6.0. Potash found 1.69, guaranteed 2.0.

**16585. Buffalo Fertilizer Co.'s Garden Truck.** Nitrogen found 2.90 per cent., guaranteed 3.3. Phosphoric acid found 8.60, guaranteed 9.0. Potash found 6.19, guaranteed 7.0.

**16584. Buffalo Farmers' Choice.** Citrate-soluble phosphoric acid found 7.65, guaranteed 8.0. Potash found 4.89, guaranteed 5.0.

**16496. Buffalo High Grade Manure.** Nitrogen found 2.61 per cent., guaranteed 3.3. Potash found 8.00, guaranteed 10.0.

**16689. Armour's Blood, Bone and Potash.** Nitrogen found 3.04 per cent., guaranteed 4.1. Phosphoric acid found 9.72, guaranteed 10.0. Potash found 5.89, guaranteed 7.0.

## COST AND VALUATION.

### *Cost.*

The method used to ascertain the retail cash cost price of the superphosphates and of commercial fertilizers in general is as follows:

The sampling agent inquires and notes the price at the time each sample is drawn. The analysis is reported to each dealer from whom a sample was taken, as well as to the manufacturer of the article, in order to give opportunity for explanation or correction as regards the price or the analysis itself. When the data thus gathered show a wide range of prices, further correspondence is required and the manufacturers are also consulted. In general an average or nearly average price forms the basis of comparison between cost and valuation. The price thus employed is printed in the following tables in full-face type.

### *Valuation.*

The valuation of a mixed fertilizer, as practiced at this station, consists in calculating the retail trade-value or cash-cost at freight centers (in raw material of good quality) of an amount of nitrogen, phosphoric acid and potash equal to that contained in one ton of the fertilizer.

The schedule of trade-values is given on page 39. The organic nitrogen in mixed fertilizers is reckoned at the price of

nitrogen in raw material of the best quality, 18½ cents per pound.

Citrate-insoluble phosphoric acid is rated at 2 cents per pound. Potash is rated at 4¼ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more potash present than will combine with the chlorine, then this excess of potash is reckoned at 5 cents per pound, except in certain special cases, to be noted later, where carbonate of potash has been used in the mixture.

In most cases the valuation of the ingredients in superphosphates and specials falls below the retail price of these goods. The difference between the two figures represents the manufacturers' charges for converting raw materials into manufactured articles and selling them. The charges are for grinding and mixing, bagging or barreling, storage and transportation, commission to agents and dealers, long credits, interest on investment, bad debts and, finally, profits.

*To obtain the valuation of a Fertilizer* we multiply the pounds per ton of nitrogen, etc., by the trade-value per pound. We thus get the values per ton of the several ingredients, and adding them together we obtain the total valuation per ton.

*Percentage Difference* given in the table shows the percentage excess of the cost price over the average retail cost, at freight centers, of the nitrogen, phosphoric acid and potash contained in the fertilizer.

This information helps the purchaser to estimate the comparative value of different brands and to determine whether it is better economy to buy the commercial mixed fertilizers, of which so many are now offered for sale, or to purchase and mix for himself the raw materials.

**The average cost per ton of the one hundred and five nitrogenous superphosphates is $31.00, the average valuation $21.00, and the percentage difference 53.9.**

Last year the corresponding averages were, cost $30.79, valuation $21.16, percentage difference 45.5.

The average composition and cost of nitrogenous superphosphates for the last six years have been as follows:

PERCENTAGE COMPOSITION.

| Year. | Nitrogen. | Total phosphoric acid. | Potash. | Cost per ton. |
|---|---|---|---|---|
| 1906 | 2.50 | 9.99 | 4.66 | $31.00 |
| 1905 | 2.56 | 10.02 | 4.59 | 30.79 |
| 1904 | 2.68 | 10.02 | 4.31 | 31.01 |
| 1903 | 2.75 | 8.12* | 4.53 | 30.39 |
| 1902 | 2.51 | 8.69* | 4.44 | 30.14 |
| 1901 | 2.52 | 8.77* | 4.48 | 28.43 |

An examination of the tables, pages 50 to 65, shows that the nitrogenous superphosphates have a wide range of composition and price. Thus one sample contains 10.48 per cent. of nitrogen, and several contain over 4 per cent. while others have but a fraction of one per cent.

Potash ranges from 11 per cent. to less than 2, and phosphoric acid from 12 to 6 per cent.

Prices range from $50 per ton to $21.00.

From this large number of widely different mixtures of plant food it is impossible to determine by simple inspection and without making calculations of some kind which fertilizers are the most economical to buy. It is certain that many of these brands the farmer cannot afford to buy.

The system of valuation applied to fertilizers has been used by this station as a help in such calculation to indicate which fertilizers are better worth buying, as far as their chemical analysis is a guide, and the analyses are arranged in the tables in an order based on the percentage difference between valuation and cost, so that those standing nearer the beginning of the table supply nitrogen, phosphoric acid and potash at a lower price per pound than those which follow them.

This valuation has been criticised as arbitrary, being based on assumed wholesale costs of the three ingredients concerned which were not always correct, or if correct one week may be incorrect the next on account of changes in the market.

The table given below, however, has no connection with any station "Valuation" but is calculated wholly from the market prices and the actual composition of the several fertilizers.

Taking the average composition of groups of about a dozen fertilizers, the table shows how much plant food can be bought for $30.00 in each of these groups.

PURCHASABLE FOR THIRTY DOLLARS.

| | Nitrogen, pounds. | Phosphoric acid, pounds. | Potash, pounds. | Cost per ton. |
|---|---|---|---|---|
| In the first 15 samples in the tables | 73 | 188 | 111 | $32.48 |
| " next 15 " " " | 57 | 161 | 129 | 33.70 |
| " " 13 " " " | 54 | 168 | 102 | 32.77 |
| " " 11 " " " | 47 | 182 | 90 | 32.64 |
| " " 12 " " " | 44 | 180 | 97 | 32.52 |
| " " 10 " " " | 38 | 222 | 60 | 28.18 |
| " " 17 " " " | 37 | 201 | 54 | 29.80 |
| " " 12 " " " | 23 | 279 | 53 | 25.00 |

This statement shows:

1. That the prices of commercial fertilizers bear no fixed relation to the amount of plant food in them, therefore, no fixed relation to their value.

2. That, *as a rule,* the low-priced superphosphates are the least economical to buy.

Thus the dozen fertilizers which cost about $25.00 per ton did not give one-third as much nitrogen nor half as much potash for the same money as the fertilizers which cost $32.50 per ton. The larger amount of phosphoric acid in the lower-priced goods is chiefly in insoluble and comparatively inert form.

### 2. *Sampled by Purchasers and Others.*

On pages 64 and 65 are tabulated five analyses of samples of nitrogenous superphosphates which were sent to the station for analysis by interested persons. The station is not responsible for the sampling of these articles.

## Nitrogenous Superphosphates.

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. |
|---|---|---|---|---|
| | *Sampled by Station Agent:* | | | |
| 16395 | Woodruff's Home Mixture | S. D. Woodruff & Sons, Orange | Manufacturer | $27.0 |
| 16582 | Manchester's Formula | E. Manchester & Sons, Winsted | Manufacturer | 30.0 |
| 16546 | Mapes' Top Dresser, Improved, full strength | Mapes F. & P. G. Co., N. Y. City | W. C. Bulkley, Forestville | 51.0 |
| | | | Mapes' Branch, Hartford | 49.0 |
| 16658 | Boardman's Complete Fertilizer | F. E. Boardman, R. D., Middletown | Manufacturer | 32.0 |
| 16686 | Bone, Fish and Potash | E. R. Kelsey, Short Beach | Elmer Ives,* Cheshire | 26.0 |
| 16729 | Southport XX Special | Am'n Agric'l Chem. Co., N. Y. City | C. Buckingham, Southport | 32.5 |
| 16592 | Complete High Grade Fertilizer | (Made for) Conn. Valley Orchard Co., Berlin | Conn. Valley Orchard Co., Berlin | 26.0 |
| 16617 | *High Grade Fish and Potash* | Wilcox Fertilizer Works, Mystic | *Manufacturer* | 28.0 |
| | | | J. M. Young, Norwich | 30.0 |
| 16806 | Mapes' Dissolved Bone | Mapes F. & P. G. Co., N. Y. City | M. D. Stanley, New Britain | 33.0 |
| | | | Mapes' Branch, Hartford | 31.0 |
| 16656 | Chittenden's Formula A | Nation'l Fertilizer Co., Bridgeport | G. W. Eaton, Plainville | 33.0 |
| | | | H. A. Bugbee, Willimantic | 33.0 |
| 6445 | Swift-Sure Superphosphate for General Use | M. L. Shoemaker & Co., Philadelphia | F. S. Bidwell & Co., Windsor Locks | 34.0 |
| | | | Olds & Whipple, Hartford | 34.0 |
| 6472 | Quinnipiac Market Garden Manure | Am'n Agric'l Chem. Co., N. Y. City | C. Buckingham, Southport | 32.5 |
| | | | H. M. Rose, Milford | 38.0 |
| | | | | 35.2 |
| 6527 | Mapes' Average Soil Complete Manure | Mapes F. & P. G. Co., N. Y. City | Southington Lumber Co., Southington | 36.0 |
| | | | Mapes' Branch, Hartford | 35.0 |
| 6670 | Chittenden's Fish and Potash | Nation'l Fertilizer Co., Bridgeport | W. E. Burbank, Suffield | 29.0 |
| | | | J. N. Lasbury, Broad Brook | 29.0 |
| 6522 | Swift's Market Garden Manure | Swift's Lowell Fertilizer Co., Boston | Weed & Turner, New Canaan | 40.0 |
| | | | Spencer Bros., Suffield | 39.0 |
| | | | | 39.5 |

* Purchaser.

## ANALYSES AND VALUATIONS.

| | Percentage difference between cost and valuation. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | As Nitrates. | As Ammonia. | Organic. | Total Nitrogen. Found. | Total Nitrogen. Guaranteed. | Water-soluble. | Citrate-soluble. | Citrate-insoluble. | Total. Found. | Total. Guaranteed. | So-called "Available." Found. | So-called "Available." Guaranteed. | Found. As Muriate. | Found. Total. | |
| 5 | 2.5 | 0.72 | --- | 2.50 | 3.22 | 3.0 | 4.96 | 3.96 | 1.21 | 10.13 | 8.0 | 8.92 | ---- | 7.78 | 7.78 | |
| 2 | 8.0 | 1.48 | --- | 2.38 | 3.86 | 3.7 | 4.00 | 4.48 | 1.26 | 9.74 | 9.0 | 8.48 | ---- | 7.53 | 7.53 | |
| 6 | 8.0 | 8.96 | 0.78 | 0.74 | 10.48 | 9.8 | 0.24 | 6.87 | 0.62 | 7.73 | 8.0 | 7.11 | ---- | 1.38 | 4.56 | |
| 8 | 9.0 | 0.05 | 0.57 | 2.63 | 3.25 | 2.9 | 5.95 | 2.23 | 0.42 | 8.60 | ---- | 8.18 | 6.0 | 11.93 | 11.93 | I |
| 5 | 9.1 | ---- | 0.68 | 2.84 | 3.52 | 2.5 | 3.79 | 2.87 | 0.32 | 6.98 | 5.0 | 6.66 | 4.0 | 0.21 | 5.14 | |
| 9 | 13.2 | 0.73 | 1.13 | 2.22 | 4.08 | 4.1 | 5.65 | 2.56 | 1.59 | 9.80 | 8.0 | 8.21 | 7.0 | 7.46 | 7.46 | |
| 2 | 17.2 | ---- | 1.15 | 1.46 | 2.61 | 2.5 | 7.20 | 2.75 | 1.04 | 10.99 | 11.0 | 9.95 | 9.0 | 4.30 | 4.30 | |
| 7 | 19.8 | ---- | 0.30 | 3.40 | 3.70 | 3.3 | 4.08 | 2.28 | 0.25 | 6.61 | 6.0 | 6.36 | ---- | 4.89 | 4.89 | |
| 5 | 21.0 | ---- | 0.34 | 2.94 | 3.28 | 2.1 | 4.42 | 11.62 | 0.67 | 16.71 | ---- | 16.04 | 12.0 | ---- | ---- | -- |
| 5 | 24.5 | 1.32 | --- | 2.00 | 3.32 | 3.3 | 4.08 | 4.60 | 2.39 | 11.07 | 9.0 | 8.68 | 6.0 | 7.57 | 7.57 | |
| 5 | 26.0 | 0.86 | --- | 2.06 | 2.92 | 2.9 | 7.49 | 5.42 | 1.30 | 14.21 | ---- | 12.91 | ---- | 0.60 | 5.01 | |
| | 28.2 | 0.88 | 0.61 | 2.03 | 3.52 | 3.3 | 6.26 | 2.99 | 1.44 | 10.69 | 9.0 | 9.25 | 8.0 | 7.46 | 7.46 | 7 |
| | 29.4 | 3.48 | 0.22 | 0.73 | 4.43 | 4.1 | 1.95 | 5.39 | 1.28 | 8.62 | 8.0 | 7.34 | 7.0 | 1.61 | 5.76 | 5 |
| | 29.5 | ---- | --- | 3.02 | 3.02 | 3.0 | 5.66 | 1.70 | 1.66 | 9.02 | 6.0 | 7.36 | ---- | 0.98 | 4.27 | 4 |
| | 29.8 | 0.25 | 0.98 | 2.92 | 4.15 | 4.1 | 4.32 | 5.54 | 1.72 | 11.58 | 8.0 | 9.86 | 7.0 | 1.30 | 6.56 | 6 |

## NITROGENOUS SUPERPHOSPHATES.

| | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | |
|---|---|---|---|---|---|
| | *Sampled by Station Agent:* | | | | |
| 13 | Packers' Union Gardeners' Complete Manure | Am'n Agric'l Chem. Co., N. Y. City | G. A. Forsyth, Waterford | $35.00 | $2 |
| | | | J. W. Gardner, Cromwell | 37.00 | |
| | | | | 36.00 | |
| 1 | Swift's Lowell Animal Brand | Swift's Lowell Fertilizer Co., Boston | Andrew Ure, Highwood | 30.00 | 2 |
| 4 | Darling's Blood, Bone and Potash | Am'n Agric'l Chem. Co., N. Y. City | B. F. Eddy, East Woodstock | 38.00 | 2 |
| 7 | Swift's Superior Fertilizer with 10% Potash | Swift's Lowell Fertilizer Co., Boston | J. W. Gardner, Cromwell | 40.00 | 2 |
| | | | E. E. Burwell, New Haven | 36.00 | |
| | | | | 38.00 | |
| 8 | North Western 10% Manure | North Western Fertilizer Co., Chicago | J. G. Schwink, Meriden | 37.00 | 2 |
| 2 | Market Garden Complete Fertilizer | Valentine Bohl, Waterbury | Manufacturer | 32.00 | 2 |
| 6 | Bowker's Fisherman's Brand Fish and Potash | Bowker Fertilizer Co., N. Y. City | B. F. Pease, Fairfield | 25.00 | 1 |
| | | | Bowker Branch, Hartford | 26.00 | |
| 7 | American Farmers' Market Garden Special | Armour Fertilizer Works, Baltimore, Md. | O. H. Meeker, Danbury | 34.00 | 2 |
| | | | S. V. Osborn, Branford | 35.00 | |
| | | | | 34.50 | |
| 0 | Wilcox's Complete Bone Superphosphate | Wilcox Fertilizer Works, Mystic | D. O. Coleman, Southington | ...... | 2 |
| | | | Manufacturer | 28.00 | |
| 0 | Bowker's Market Garden Fertilizer | Bowker Fertilizer Co., N. Y. City | Bowker Branch, Hartford | 35.00 | 2 |
| | | | J. F. Silliman & Co., New Canaan | 37.00 | |
| 3 | Mapes' Top Dresser, Improved, *Half* Strength | Mapes F. & P. G. Co., N. Y. City | Mapes' Branch, Hartford | 32.00 | 2 |
| | | | F. S. Bidwell & Co., Windsor Locks | 33.00 | |
| 3 | Williams & Clark's High Grade Special | Am'n Agric'l Chem. Co., N. Y. City | T. B. Atwater, Plantsville | 37.00 | 2 |
| 9 | Hubbard's Market Garden Phosphate | The Rogers & Hubbard Co., Middletown | F. S. Loomis, Windsor | 38.00 | 2 |
| 5 | Chittenden's XXX Fish and Potash | National Fertilizer Co., Bridgeport | D. L. Clark, Milford | 28.00 | 1 |
| | | | F. H. Rolf, Guilford | 24.00 | |
| | | | | 26.00 | |
| 1 | Complete Manure with 10% Potash | Am'n Agric'l Chem. Co., N. Y. City | D. L. Clark, Milford | 38.00 | 2 |

## ANALYSES AND VALUATIONS—*Continued.*

| | Percentage difference between cost and valuation. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | As Nitrates. | As Ammonia. | Organic. | Total Nitrogen. | | Water-soluble. | Citrate-soluble. | Citrate-insoluble. | Total. | | So-called "Available." | | Found. | |
| | | | | | Found. | Guaranteed. | | | | Found. | Guaranteed. | Found. | Guaranteed. | As Muriate. | Total. |
| )3 | 31.9 | 0.73 | --- | 2.43 | 3.16 | **2.4** | 4.74 | 2.58 | 1.51 | 8.83 | **7.0** | 7.32 | **6.0** | 7.24 | 10.05 |
| 11 | 32.3 | ---- | 0.13 | 2.31 | 2.44 | **2.5** | 7.15 | 3.94 | 1.46 | 12.55 | **10.0** | 11.09 | **9.0** | 4.10 | 4.10 |
| 34 | 34.4 | 1.21 | --- | 2.66 | 3.87 | **4.1** | 3.86 | 4.61 | 1.69 | 10.16 | **8.0** | 8.47 | **7.0** | 7.76 | 7.76 |
| 17 | 34.9 | 0.90 | 0.34 | 2.12 | 3.36 | **3.7** | 4.51 | 4.06 | 1.14 | 9.71 | **8.0** | 8.57 | **7.0** | 9.87 | 9.87 |
| 08 | 35.0 | 0.63 | 1.01 | 1.68 | 3.32 | **3.0** | 5.20 | 1.79 | 1.16 | 8.15 | **7.0** | 6.99 | **6.0** | 10.59 | 10.59 |
| 52 | 35.0 | 1.68 | --- | 1.73 | 3.41 | **3.0** | none | 4.41 | 6.52 | 10.93 | **10.0** | 4.41 | ---- | 6.61 | 6.61 |
| 56 | 35.1 | 0.46 | 0.12 | 2.24 | 2.82 | **2.5** | 4.14 | 1.15 | 0.84 | 6.13 | **5.0** | 5.29 | **4.0** | 4.73 | 4.73 |
| 97 | 35.1 | 0.65 | 0.64 | 1.82 | 3.11 | **3.3** | 7.26 | 1.84 | 0.35 | 9.45 | **10.0** | 9.10 | **8.0** | 4.22 | 6.91 |
| !20 | 36.0 | 0.39 | --- | 1.93 | 2.32 | **2.1** | 5.81 | 4.34 | 0.98 | 11.13 | **9.0** | 10.15 | **8.0** | 3.51 | 3.60 |
| !70 | 36.0 | 0.56 | --- | 2.28 | 2.84 | **2.5** | 5.01 | 1.77 | 0.72 | 7.50 | 7.0 | 6.78 | **6.0** | 10.85 | 10.85 |
| 543 | 37.1 | 4.99 | 0.15 | 0.26 | 5.40 | **5.0** | 0.88 | 2.65 | 0.44 | 3.97 | **4.0** | 3.53 | ---- | 1.05 | 2.45 |
| 733 | 37.6 | 0.73 | 1.10 | 1.57 | 3.40 | **3.3** | 7.12 | 1.97 | 1.09 | 10.18 | **9.0** | 9.09 | **8.0** | 7.51 | 7.51 |
| 509 | 39.0 | 1.85 | --- | 1.23 | 3.08 | **3.5** | 5.15 | 3.76 | 0.38 | 9.29 | **8.5** | 8.91 | **7.5** | 10.43 | 10.4 |
| 455 | 39.3 | ---- | --- | 2.44 | 2.44 | **2.5** | 5.04 | 1.49 | 2.86 | 9.39 | **7.0** | 6.53 | **5.0** | 0.63 | 2.8 |
| 711 | 39.4 | 0.53 | 1.08 | 1.67 | 3.28 | **2.5** | 5.21 | 1.80 | 1.23 | 8.24 | **7.0** | 7.01 | **6.0** | 10.51 | 10.5 |

## Nitrogenous Superphosphates.

| | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | Valuati[…] |
|---|---|---|---|---|---|
| | *Sampled by Station Agent:* | | | | |
| | Sanderson's Formula A | Sanderson Fertilizer and Chemical Co., New Haven | C. D. Owen, Southington | $33.00 | $24 |
| | | | Morse & Landon, Guilford | 34.00 | |
| | | | | **33.50** | |
| !* | A. A. Brand | Parmenter & Polsey Fertilizer Co., Peabody, Mass. | Jos. R. Norton, Broad Brook | 38.50 | 27 |
| | | | A. R. Holcomb,† West Suffield | 38.00 | |
| | North Western Market Garden Phosphate | North Western Fertilizer Co., Chicago | G. W. Eaton, Bristol | 34.00 | 23 |
| | | | C. Buckingham, Southport | 32.00 | |
| | | | | **33.00** | |
| | Darling's General Fertilizer | Am'n Agric'l Chem. Co., N. Y. City | A. D. Zabriski, Norwich | 28.00 | 1 |
| ‡ | Long Islander Market Garden Special | Coe-Mortimer Co., N. Y. City | W. L. & S. T. Merwin, Milford | 34.00 | 24 |
| | | | Atwater Bros., New Haven | 34.00 | |
| | Fish and Potash Fertilizer | Rogers Mfg. Co., Rockfall | Geo. Meachen, Stratford | 30.00 | 21 |
| | | | Manufacturer | 30.00 | |
| | High Grade Fertilizer with 10% Potash | Am'n Agric'l Chem. Co., N. Y. City | J. Blackwell, Bloomfield | 36.00 | 25 |
| | O. & W's Special Phosphate | Olds & Whipple, Hartford | Manufacturer | 34.00 | 23 |
| | Bowker's Middlesex Special | Bowker Fertilizer Co., N. Y. City | W. T. McKenzie, Yalesville | 25.00 | 18 |
| | | | August Grulick, Meriden | 28.00 | |
| | | | | **26.50** | |
| | Swift's Lowell Animal Brand | Swift's Lowell Fertilizer Co. Boston | F. S. Bidwell & Co., Windsor Locks | 34.00 | 2 |
| | | | Spencer Bros., Suffield | 33.00 | |
| | | | | **33.50** | |
| | Church's Fish and Potash | Am'n Agric'l Chem. Co., N. Y. City | A. H. Cashen, Meriden | 26.00 | 17 |
| | Chittenden's Complete *Fertilizer* | National Fertilizer *Co., Bridgeport* | G. A. Williams, Silver *Lane* | 37.00 | 25 |
| | Berkshire Complete Fertilizer | Berkshire Fertilizer Co., Bridgeport | Loomis Bros., Granby | 34.00 | 23 |
| | | | Hotchkiss & Templeton, Waterbury | 36.00 | |
| | | | | **35.00** | |
| * | Buffalo Garden Truck | Buffalo Fertilizer Co., Buffalo, N. Y. | E. H. Talcott, Torrington | 34.00 | 23 |
| | | | Bishop & Lynes, Norwalk | 35.00 | |
| | | | | **34.50** | |

ANALYSES AND VALUATIONS—*Continued.*

| between cost and valuation. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Total Nitrogen. | | | | | Total | | So-called "Available." | | Found. | | |
| | As Nitrates. | As Ammonia. | Organic. | Found. | Guaranteed. | Water-soluble. | Citrate-soluble. | Citrate-insoluble. | Found. | Guaranteed. | Found. | Guaranteed. | As Muriate. | Total. | Guaranteed. |
| 39.5 | 0.66 | ... | 2.68 | 3.34 | **3.3** | 3.38 | 3.82 | 1.46 | 8.66 | **9.0** | 7.20 | **6.0** | 6.16 | 6.16 | **6.0** |
| 39.6 | 0.44 | 0.62 | 2.45 | 3.51 | **4.1** | 3.58 | 5.77 | 1.42 | 10.77 | **8.0** | 9.35 | **7.0** | 4.64 | 7.17 | **8.0** |
| 39.8 | 0.41 | 0.48 | 1.76 | 2.65 | **2.5** | 7.07 | 1.87 | 0.71 | 9.65 | **9.0** | 8.94 | **8.0** | 6.96 | 6.96 | **6.0** |
| 40.1 | 0.06 | ... | 2.32 | 2.38 | **1.2** | 4.99 | 3.46 | 1.98 | 10.43 | **9.0** | 8.45 | **8.0** | 3.71 | 3.71 | **3.0** |
| 41.3 | 0.64 | 1.46 | 0.90 | 3.00 | **3.4** | 6.82 | 1.96 | 1.25 | 10.03 | **10.0** | 8.78 | **8.5** | 2.53 | 5.69 | **6.0** |
| 41.8 | 0.99 | ... | 2.36 | 3.35 | **3.3** | 2.43 | 3.99 | 0.97 | 7.39 | **6.0** | 6.42 | **4.0** | 3.99 | 3.99 | **3.8** |
| 43.4 | 0.58 | ... | 2.12 | 2.70 | **2.5** | 4.93 | 1.93 | 0.97 | 7.83 | **7.0** | 6.86 | **6.0** | 10.58 | 10.58 | **10.0** |
| 43.9 | .... | 1.08 | 3.30 | 4.38 | **4.1** | 0.72 | 4.96 | 0.86 | 6.54 | .... | 5.68 | **4.0** | 1.09 | 2.83 | **3.0** |
| 44.8 | 0.10 | ... | 2.18 | 2.28 | **2.1** | 3.79 | 1.73 | 0.97 | 6.49 | **5.0** | 5.52 | **4.0** | 5.55 | 5.55 | **6.0** |
| 45.1 | .... | ... | 2.47 | 2.47 | **2.5** | 6.77 | 4.15 | 2.46 | 13.38 | **10.0** | 10.92 | **9.0** | 4.19 | 4.19 | **4.0** |
| 45.3 | .... | ... | 2.28 | 2.28 | **2.1** | 4.67 | 3.02 | 1.60 | 9.29 | **7.0** | 7.69 | **6.0** | 2.58 | 2.58 | **2.0** |
| 46.0 | 0.54 | 0.51 | 2.29 | 3.34 | **3.3** | 7.28 | 1.63 | 0.53 | 9.44 | **10.0** | 8.91 | **8.0** | 6.16 | 6.16 | **6.0** |
| 46.4 | 0.19 | ... | 2.63 | 2.82 | **2.5** | 7.28 | 1.93 | 0.26 | 9.47 | **10.0** | 9.21 | **8.0** | 6.29 | 6.29 | **6.0** |
| 47.3 | 0.18 | 1.48 | 1.24 | 2.90 | **3.3** | 5.17 | 2.27 | 1.16 | 8.60 | **9.0** | 7.44 | **8.0** | 0.40 | 6.19 | **7.[illegible]** |

## NITROGENOUS SUPERPHOSPHATES.

| Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | [illegible] |
|---|---|---|---|---|
| *Sampled by Station Agent:* | | | | |
| Wilcox's Fish and Potash | Wilcox Fertilizer Works, Mystic | Olds & Whipple, Hartford | $29.00 | $19 |
| | | Spencer Bros., Suffield | 28.00 | |
| | | | **28.50** | |
| Darling's Dissolved Bone and Potash | Am'n Agric'l Chem. Co., N. Y. City | C. M. Beach, New Milford | 36.00 | 24 |
| | | Spencer Bros., Suffield | 37.00 | |
| | | | **36.50** | |
| Buffalo York State Special | Buffalo Fertilizer Co., Buffalo, N. Y. | Bishop & Lynes, Norwalk | **28.00** | 18 |
| | | Warner & Hardin, Glastonbury | ------ | |
| East India A. A. Ammoniated Superphosphate | Am'n Agric'l Chem. Co., N. Y. City | F. J. Hartz, R. F. D., South Manchester | **32.00** | 21 |
| High Grade Ammoniated Bone Superphosphate | Coe-Mortimer Co., N. Y. City | J. P. Barstow, Norwich | 32.00 | 20 |
| | | A. L. Burdick, Westbrook | 29.00 | |
| | | | **30.50** | |
| Chittenden's Market Garden Fertilizer | National Fertilizer Co., Bridgeport | Henry Davis,* Thompsonville | **35.00** | 22 |
| †Red Brand Excelsior Guano | Coe-Mortimer Co., N. Y. City | A. L. Burdick, Westbrook | 36.00 | 23 |
| | | Atwater Bros., New Haven | 35.00 | |
| | | | **35.50** | |
| Armour's All Soluble | Armour Fertilizer Works, Baltimore | H. K. Brainard, Thompsonville | **33.00** | 21 |
| | | Lightbourn & Pond Co., New Haven | 33.00 | |
| Darling's Farm Favorite | Am'n Agric'l Chem. Co., N. Y. City | A. D. Zabriski, Norwich | **30.00** | 19 |
| | | B. F. Eddy, East Woodstock | 30.00 | |
| New England Superphosphate | N. E. Fertilizer Co., Boston | M. D. Stanley, New Britain | 36.00 | 23 |
| | | Hitchcock Hardware Co., Watertown | 35.00 | |
| | | | **35.50** | |
| Bradley's Farmers' New Method Fertilizer | Am'n Agric'l Chem. Co., N. Y. City | Avery Bros., Norwich Town | 31.00 | 19 |
| | | D. L. Clark, Milford | 28.00 | |
| | | | **29.50** | |
| †Sanderson's Special with 10% Potash | Sanderson Fertilizer & Chemical Co., New Haven | Manufacturer | **38.00** | 24 |

* Stock of Patrick Manning. † See notice on page 44.

## Analyses and Valuations—*Continued.*

| | Percentage difference between cost and valuation. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | As Nitrates. | As Ammonia. | Organic. | Total Nitrogen. Found. | Total Nitrogen. Guaranteed. | Water-soluble. | Citrate-soluble. | Citrate-insoluble. | Total. Found. | Total. Guaranteed. | So-called "Available." Found. | So-called "Available." Guaranteed. | Found. As Muriate. | Found. Total. | Guaranteed. |
| . | 48.6 | ---- | 0.28 | 2.50 | 2.78 | 2.5 | 3.90 | 2.24 | 1.18 | 7.32 | 6.0 | 6.14 | 5.0 | 3.74 | 3.74 | 3 |
| 1 | 50.1 | 0.47 | --- | 2.05 | 2.52 | 2.5 | 5.23 | 2.08 | 1.03 | 8.34 | 7.0 | 7.31 | 6.0 | 9.87 | 9.87 | 1( |
| 3 | 50.5 | 0.21 | --- | 1.59 | 1.80 | 1.6 | 4.54 | 2.99 | 1.46 | 8.99 | 10.0 | 7.53 | 9.0 | 1.53 | 5.21 | ! |
| 2 | 50.6 | 0.68 | --- | 2.08 | 2.76 | 2.5 | 6.83 | 2.68 | 2.09 | 11.80 | 11.0 | 9.71 | 9.0 | 2.38 | 2.38 | ; |
| 3 | 51.6 | 0.40 | --- | 1.80 | 2.20 | 1.9 | 7.38 | 1.94 | 1.40 | 10.72 | 11.0 | 9.32 | 9.0 | 0.80 | 3.51 | |
| 0 | 52.3 | 0.42 | 0.51 | 1.65 | 2.58 | 2.5 | 7.47 | 1.79 | 1.20 | 10.46 | 9.0 | 9.26 | 8.0 | 5.95 | 5.95 | |
| 8 | 52.6 | 1.10 | 0.50 | 1.16 | 2.76 | 3.3 | 7.04 | 2.07 | 1.44 | 10.55 | 10.0 | 9.11 | 9.0 | 1.64 | 5.26 | |
| 3 | 52.8 | 1.06 | --- | 1.84 | 2.90 | 2.9 | 5.92 | 2.26 | 0.70 | 8.88 | 10.0 | 8.18 | 8.0 | 4.55 | 4.55 | |
| 51 | 53.1 | 0.35 | --- | 1.92 | 2.27 | 2.1 | 6.21 | 2.53 | 2.06 | 10.80 | 10.0 | 8.74 | 8.0 | 3.41 | 3.41 | |
| 76 | 53.3 | ---- | --- | 2.53 | 2.53 | 2.5 | 6.96 | 4.02 | 2.11 | 13.09 | 10.0 | 10.98 | 9.0 | 4.09 | 4.09 | |
| 61 | 53.6 | 0.38 | --- | 1.74 | 2.12 | 1.7 | 6.96 | 2.04 | 1.50 | 10.50 | 9.0 | 9.00 | 8.0 | 3.56 | 3.56 | |
| 65 | 53.7 | ---- | --- | 2.55 | 2.55 | 2.5 | 3.68 | 3.31 | 2.16 | 9.15 | 8.0 | 6.99 | 5.0 | 7.79 | 9.64 | |

## NITROGENOUS SUPERPHOSPHATES.

| | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | |
|---|---|---|---|---|---|
| | *Sampled by Station Agent**: | | | | |
| 7* | Sanderson's Special with 10% Potash | Sanderson Fertilizer & Chemical Co., New Haven | G. W. Eaton, Plainville | $35.00 | $2 |
| | | | E. H. Wilcox, Winsted | ------ | |
| 7 | Plymouth Rock Brand | Parmenter & Polsey Fertilizer Co., Peabody, Mass. | Arthur Williams, So. Woodstock | 31.50 | 2 |
| | | | James T. Hill, Suffield | 34.00 | |
| | | | | **32.75** | |
| [illegible] | Armour's Ammoniated Bone with Potash | Armour Fertilizer Works, Baltimore | Edward White, Rockville | 29.00 | 1 |
| | | | O. H. Meeker, Danbury | 26.00 | |
| | | | | **27.50** | |
| [illegible]† | Buffalo High Grade Manure | Buffalo Fertilizer Co., Buffalo, N. Y. | Bishop & Lynes, Norwalk | 37.00 | 2 |
| | | | J. F. Silliman & Co., New Canaan | 36.00 | |
| | | | | **36.50** | |
| 9† | Armour's Blood, Bone and Potash | Armour Fertilizer Works, Baltimore | Lightbourn & Pond Co., New Haven | 40.00 | 2 |
| | | | Geo. H. Lowerre, Jr., Jewett City | 36.00 | |
| | | | | **38.00** | |
| [illegible] | Chittenden's Ammoniated Bone Phosphate | National Fertilizer Co., Bridgeport | Chas. S. Fox, Fairfield | **26.50** | 1 |
| | | | G. A. Williams, Silver Lane | ------ | |
| [illegible] | Hubbard's Soluble Corn and General Crops Manure | Rogers & Hubbard Co., Middletown | C. H. Wheeler, East Canaan | 38.00 | 2 |
| | | | H. W. Andrews, Wallingford | 36.00 | |
| | | | | **37.00** | |
| [illegible] | All Round Fertilizer | Rogers Mfg. Co., Rockfall | Manufacturer | **28.00** | 1 |
| | | | A. A. Blakeslee, Wallingford | 28.00 | |
| [illegible] | Mapes' Complete Manure A Brand | Mapes F. & P. G. Co., N. Y. City | Mapes' Branch, Hartford | **34.00** | 21 |
| | | | Birdsey & Raven, Meriden | 35.00 | |
| [illegible] | Packers' Union Universal Fertilizer | Am'n Agric'l Chem. Co., N. Y. City | G. A. Forsyth, Waterford | **27.50** | 17 |
| | | | J. W. Gardner, Cromwell | 28.00 | |
| [illegible] | American Farmers' Fish and Potash Mixture | Armour Fertilizer Works, Baltimore | Young Bros. Co., Danielson | 26.00 | 15 |
| | | | S. V. Osborn, Branford | 24.00 | |
| | | | Lightbourn & Pond Co., New Haven | 24.00 | |
| | | | | **25.00** | |

* See notice on page 44. † See note under guaranties, p. 46.

## Analyses and Valuations—*Continued.*

| | Percentage difference between cost and valuation. | Nitrogen. As Nitrates. | Nitrogen. As Ammonia. | Nitrogen. Organic. | Total Nitrogen. Found. | Total Nitrogen. Guaranteed. | Phosphoric Acid. Water-soluble. | Phosphoric Acid. Citrate-soluble. | Phosphoric Acid. *Citrate-insoluble.* | Total. Found. | Total. Guaranteed. | So-called "Available." Found. | So-called "Available." Guaranteed. | Potash. Found. As Muriate. | Potash. Found. Total. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 53.8 | .... | ... | 2.36 | 2.36 | **2.5** | 4.02 | 2.62 | 1.97 | 8.61 | **8.0** | 6.64 | **5.0** | 7.13 | 8.58 | I |
| 7 | 54.3 | .... | ... | 2.40 | 2.40 | **2.5** | 5.66 | 4.06 | 0.85 | 10.57 | **9.0** | 9.72 | **8.0** | 4.31 | 4.31 | |
| 9 | 54.5 | 0.90 | 0.22 | 1.36 | 2.48 | **2.5** | 5.10 | 2.55 | 0.67 | 8.32 | **7.0** | 7.65 | **6.0** | 2.51 | 2.51 | |
| 6 | 55.8 | 0.15 | 1.34 | 1.12 | 2.61 | **3.3** | 4.43 | 2.57 | 1.20 | 8.20 | **8.0** | 7.00 | **7.0** | 2.91 | 8.00 | I |
| 39 | 56.1 | 0.04 | 0.63 | 2.37 | 3.04 | **4.1** | 6.72 | 2.45 | 0.55 | 9.72 | **10.0** | 9.17 | **8.0** | 5.89 | 5.89 | |
| 75 | 56.8 | .... | ... | 1.84 | 1.84 | **1.8** | 7.04 | 1.70 | 0.96 | 9.70 | **10.0** | 8.74 | **8.0** | 2.37 | 2.37 | |
| 76 | 56.8 | 1.08 | ... | 1.44 | 2.52 | **2.5** | 3.50 | 4.49 | 0.97 | 8.96 | **8.0** | 7.99 | **6.0** | 8.92 | 8.92 | |
| 69 | 57.4 | 1.31 | ... | 0.81 | 2.12 | **1.7** | 5.54 | 3.57 | 0.95 | 10.06 | **10.0** | 9.11 | **8.0** | 2.63 | 2.63 | |
| 00 | 57.6 | 1.38 | 0.43 | 0.89 | 2.70 | **2.5** | 3.73 | 6.43 | 2.85 | 13.01 | **12.0** | 10.16 | **10.0** | 3.05 | 3.05 | |
| 53 | 57.7 | 0.34 | ... | 1.31 | 1.65 | **0.8** | 5.44 | 3.10 | 2.10 | 10.64 | **9.0** | 8.54 | **8.0** | 3.82 | 3.82 | |
| 90 | 57.9 | 0.62 | ... | 1.46 | 2.08 | **2.1** | 4.91 | 1.89 | 0.38 | 7.18 | **7.0** | 6.80 | **6.0** | 2.70 | 2.70 | |

## NITROGENOUS SUPERPHOSPHATES.

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. |
|---|---|---|---|---|
| | *Sampled by Station Agent:* | | | |
| 572 | Williams & Clark's Ammoniated Bone Superphosphate | Am'n Agric'l Chem. Co., N. Y. City | W. A. Buxton, Westford | $35.00 |
| | | | R. H. Hall, East Hampton | 34.00 |
| | | | | **34.50** |
| 553 | Hubbard's Complete Phosphate | Rogers & Hubbard Co. Middletown | E. T. Clark, Milford | 26.00 |
| | | | H. W. Andrews, Wallingford | 26.00 |
| | | | F. S. Bidwell & Co., Windsor Locks | 28.00 |
| | | | | **27.00** |
| 584 | Star Brand Superphosphate | Parmenter & Polsey Fertilizer Co., Peabody, Mass. | Arthur Williams, So. Woodstock | **28.00** |
| 571 | Success Fertilizer | Lister's Agricultural Chemical Works, Newark, N. J. | J. A. Foster, Stafford Springs | 26.50 |
| | | | C. H. Sage, East Canaan | 28.00 |
| | | | | **27.25** |
| 584* | Buffalo Farmers' *Choice* | Buffalo Fertilizer Co., *Buffalo, N. Y.* | E. H. Talcott, Torrington | **24.00** |
| | | | Bishop & Lynes, Norwalk | 24.00 |
| 518 | Bowker's Hill & Drill Phosphate | Bowker Fertilizer Co., N. Y. City | J. P. Barstow, Norwich | 35.00 |
| | | | W. O. Goodsell, Bristol | 33.00 |
| | | | | **34.00** |
| 97 | E. Frank Coe's XXV Ammoniated Bone Phosphate | Coe-Mortimer Co., N. Y. City | W. E. Warner & Bro., Westville | **28.00** |
| 98 | Lister's Standard Superphosphate | Lister's Agric'l Chem. Wks, Newark, N. J. | A. I. Martin, Wallingford | **32.00** |
| 19 | Buffalo Fish Guano | Buffalo Fertilizer Co., Buffalo, N. Y. | A. L. Burdick, Westbrook | **22.00** |
| | | | Lightbourn & Pond Co., New Haven | 22.00 |
| 54 | Essex XXX Fish and Potash | Russia Cement Co., Gloucester, Mass. | M. D. Stanley, New Britain | 34.00 |
| | | | Spencer Bros., Suffield | 32.00 |
| | | | | **33.00** |
| 42 | Bradley's Superphosphate | Am'n Agric'l Chem. Co., *N. Y. City* | Spencer Bros., Suffield | **34.00** |
| | | | F. S. Bidwell & Co., Windsor Locks | 34.00 |
| 74 | Quinnipiac Phosphate | Am'n Agric'l Chem. Co., N. Y. City | G. A. Root & Son, Forestville | 35.00 |
| | | | G. M. Williams Co., New London | 34.00 |
| | | | | **34.50** |

ANALYSES AND VALUATIONS—*Continued.*

| | Percentage difference between cost and valuation. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | As Nitrates. | As Ammonia. | Organic. | Total Nitrogen. | | Water-soluble. | Citrate-soluble. | Citrate-insoluble. | Total. | | So-called "Available." | | Found. | |
| | | | | | Found. | Guaranteed. | | | | Found. | Guaranteed. | Found. | Guaranteed. | As Muriate. | Total. |
| 2 | 58.3 | 0.77 | --- | 1.99 | 2.76 | 2.5 | 7.04 | 3.34 | 2.13 | 12.51 | 11.0 | 10.38 | 9.0 | 2.40 | 2.40 |
| 3 | 59.3 | 0.13 | --- | 1.00 | 1.13 | 1.0 | 6.06 | 4.28 | 0.74 | 11.08 | 10.0 | 10.34 | 8.0 | 4.29 | 4.29 |
| 34 | 59.5 | .... | ... | 1.90 | 1.90 | 1.6 | 5.74 | 3.56 | 1.04 | 10.34 | 8.0 | 9.30 | 7.0 | 2.46 | 2.46 |
| 71 | 60.1 | .... | ... | 1.58 | 1.58 | 1.2 | 5.41 | 5.10 | 1.45 | 11.96 | 11.0 | 10.51 | 9.0 | 1.93 | 1.93 |
| 84 | 62.8 | .... | ... | 0.79 | 0.79 | 0.8 | 3.09 | 4.56 | 1.36 | 9.01 | 9.0 | 7.65 | 8.0 | 0.27 | 4.89 |
| 18 | 63.5 | 0.28 | ... | 2.53 | 2.81 | 2.5 | 7.26 | 1.86 | 0.92 | 10.04 | 10.0 | 9.12 | 9.0 | 2.51 | 2.51 |
| 97 | 64.0 | 0.48 | ... | 0.92 | 1.40 | 0.8 | 7.66 | 2.05 | 1.93 | 11.64 | 10.0 | 9.71 | 8.5 | 0.53 | 2.87 |
| 98 | 64.8 | 0.98 | 0.46 | 1.03 | 2.47 | 2.5 | 6.26 | 3.90 | 0.77 | 10.93 | 11.0 | 10.16 | 9.0 | 2.01 | 2.01 |
| 19 | 65.2 | 0.09 | ... | 0.96 | 1.05 | 0.8 | 4.21 | 3.70 | 1.67 | 9.58 | 10.0 | 7.91 | 9.0 | 1.06 | 2.21 |
| 54 | 65.8 | 0.40 | ... | 1.90 | 2.30 | 2.1 | 3.71 | 5.28 | 4.39 | 13.38 | 12.0 | 8.99 | 9.0 | 2.62 | 2.62 |
| 42 | 67.6 | 0.52 | ... | 2.01 | 2.53 | 2.5 | 7.70 | 2.06 | 0.72 | 10.48 | 10.0 | 9.76 | 9.0 | 2.66 | 2.66 |
| 74 | 68.2 | 0.66 | ... | 1.96 | 2.62 | 2.5 | 7.28 | 2.22 | 1.69 | 11.19 | 11.0 | 9.50 | 9.0 | 2.43 | 2.4[illegible] |

## NITROGENOUS SUPERPHOSPHATES.

| Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | Valuation per ton. |
|---|---|---|---|---|
| *Sampled by Station Agent:* | | | | |
| Atlantic Coast Bone, Fish and Potash | Sanderson Fertilizer & Chemical Co., New Haven | Manufacturer | $26.00 | $15 |
| | | Morse & Landon, Guilford | 24.00 | |
| Swift's Lowell Dissolved Bone and Potash | Swift's Lowell Fertilizer Co., Boston | F. S. Bidwell & Co., Windsor Locks | 30.00 | 17 |
| | | Standard Feed Co., Bridgeport | 30.00 | |
| Swift's Lowell Bone Fertilizer | Swift's Lowell Fertilizer Co., Boston | Standard Feed Co., Bridgeport | 30.00 | 17 |
| | | F. S. Bidwell, Windsor Locks | 31.00 | |
| | | | 30.50 | |
| Bowker's Square Brand Bone and Potash | Bowker Fertilizer Co., N. Y. | Ansonia Flour & Grain Co., Ansonia | 29.00 | 16 |
| | | A. R. Manning, Yantic | 29.00 | |
| North Western Superphosphate | North Western Fertilizing Co., Chicago | G. W. Eaton, Bristol | 34.00 | 19 |
| Eldredge's Special Fish & Potash Fertilizer | (Made for) T. H. Eldredge, Norwich | T. H. Eldredge, Norwich | 30.00 | 17 |
| Berkshire Ammoniated Bone Phosphate | Berkshire Fertilizer Co., Bridgeport | Avery Bros., Norwich Town | 28.00 | 15 |
| | | F. C. Benjamin, Danbury | 28.00 | |
| North Western Complete Compound | North Western Fertilizer Co., Chicago | M. P. McKenna, R. F. D. Stratford | 28.00 | 15 |
| *E. Frank Coe's Fish & Potash, F. P. Brand | Coe-Mortimer Co., N. Y. City | J. R. Babcock, Mystic | 27.00 | 14 |
| | | A. L. Burdick, Westbrook | 26.00 | |
| | | | 26.50 | |
| Bowker's Farm and Garden Phosphate | Bowker Fertilizer Co., N. Y. City | M. E. Taylor, Kensington | 30.00 | 16 |
| | | Collinsville Grain Co., Collinsville | 30.00 | |
| North Western Fish, Bone and Potash | North Western Fertilizer Co., Chicago | J. Blackwell, Bloomfield | 31.00 | 17 |
| Eldredge's Special Superphosphate | (Made for) T. H. Eldredge, Norwich | T. H. Eldredge, Norwich | 28.00 | 14 |
| Crocker's New Rival Fertilizer | Am'n Agric'l Chem. Co., N. Y. City | F. M. Loomis, North Granby | 28.00 | 14 |
| Chittenden's Universal Phosphate | National Fertilizer Co., Bridgeport | F. C. Benjamin, Danbury | 26.00 | 13 |
| Gloucester Fish and Potash | Bowker Fertilizer Co., N. Y. City | Lightbourn & Pond Co., New Haven | 24.00 | 12 |
| | | W. T. McKenzie, Yalesville | 25.00 | |
| | | | 24.50 | |

* See note under guaranties, p. 46.

ANALYSES AND VALUATIONS—*Continued.*

| Percentage difference between cost and valuation. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | As Nitrates. | As Ammonia. | Organic. | Total Nitrogen. | | Water-soluble. | Citrate-soluble. | Citrate-insoluble. | Total. | | So-called "Available." | | Found. | | Guaranteed. |
| | | | | *Found.* | Guaranteed. | | | | Found. | Guaranteed. | Found. | Guaranteed. | As Muriate. | Total. | |
| 69.4 | ---- | 0.20 | 1.60 | 1.80 | **1.6** | 2.80 | 2.50 | 1.26 | 6.56 | **6.0** | 5.30 | **4.0** | 4.36 | 4.36 | **4.** |
| 69.5 | ---- | --- | 1.69 | 1.69 | **1.6** | 6.80 | 3.45 | 1.85 | 12.10 | **10.0** | 10.25 | **9.0** | 2.15 | 2.15 | **2.** |
| 71.7 | ---- | --- | 1.70 | 1.70 | **1.6** | 6.83 | 2.41 | 1.69 | 10.93 | **9.0** | 9.24 | **8.0** | 3.19 | 3.19 | **3.** |
| 74.1 | 0.31 | --- | 1.55 | 1.86 | **1.7** | 2.96 | 5.23 | 2.81 | 11.00 | **7.0** | 8.19 | **6.0** | 2.28 | 2.28 | **2.** |
| 75.4 | 0.44 | --- | 2.06 | 2.50 | **2.5** | 7.86 | 1.86 | 0.68 | 10.40 | **10.0** | 9.72 | **9.0** | 2.42 | 2.42 | **2.** |
| 76.1 | ---- | 0.27 | 1.77 | 2.04 | **1.7** | 4.53 | 1.65 | 0.23 | 6.41 | **6.0** | 6.18 | **5.0** | 4.76 | 4.76 | **4.** |
| 79.4 | ---- | --- | 1.44 | 1.44 | **0.8** | 6.75 | 2.49 | 0.35 | 9.59 | **10.0** | 9.24 | **8.0** | 2.44 | 2.44 | **2.** |
| 79.4 | ---- | --- | 1.06 | 1.06 | **0.8** | 7.07 | 1.70 | 0.88 | 9.65 | **9.0** | 8.77 | **8.0** | 4.26 | 4.26 | **4.** |
| 80.3 | ---- | --- | 2.07 | 2.07 | **2.0** | 3.28 | 2.54 | 1.54 | 7.36 | **7.0** | 5.82 | **6.0** | 1.69 | 1.69 | **2.** |
| 80.7 | 0.22 | --- | 1.62 | 1.84 | **1.7** | 6.53 | 2.29 | 1.34 | 10.16 | **9.0** | 8.82 | **8.0** | 1.92 | 1.92 | **2.** |
| 81.2 | ---- | --- | 2.50 | 2.50 | **2.5** | 2.37 | 2.62 | 1.53 | 6.52 | **5.0** | 4.99 | **4.0** | 3.55 | 3.55 | **4.** |
| 86.9 | ---- | --- | 1.25 | 1.25 | **1.0** | 6.91 | 2.61 | 0.36 | 9.88 | **10.0** | 9.52 | **8.0** | 2.24 | 2.24 | **2.** |
| 87.3 | ---- | --- | 1.10 | 1.10 | **1.0** | 7.42 | 1.68 | 2.76 | 11.86 | **9.0** | 9.10 | **8.0** | 2.07 | 2.07 | **2.** |
| 87.5 | ---- | --- | 0.80 | 0.80 | **0.8** | 7.07 | 2.21 | 4.36 | 13.64 | **10.0** | 9.28 | **8.0** | 1.22 | 1.22 | **1.** |
| 89.3 | 0.07 | --- | 0.93 | 1.00 | **0.8** | 6.53 | 2.11 | 1.24 | 9.88 | **9.0** | 8.64 | **8.0** | 1.41 | 1.41 | **1.** |

## NITROGENOUS SUPERPHOSPHATES.

| Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | |
|---|---|---|---|---|
| *Sampled by Station Agent:* | | | | |
| Read's Standard Superphosphate | Am'n Agric'l Chem. Co., N. Y. City | G. K. Goodwin, East Canaan | $29.00 | $1 |
| | | H. A. Welton, Thomaston | 31.00 | |
| | | | **30.00** | |
| Animal Bone and Potash | Lister's Agric'l Chem. Wks., Newark, N. J. | D. C. Burnham, Moodus | **21.00** | 1 |
| Bradley's Eclipse Phosphate | Am'n Agric'l Chem. Co., N. Y. City | F. M. Cole, Putnam | **29.00** | 1 |
| Swift's Lowell Empress Brand | Swift's Lowell Fertilizer Co., Boston | Southington Lumber Co., Southington | 29.00 | 1 |
| | | Weed & Turner, New Canaan | 30.00 | |
| | | | **29.50** | |
| Quinnipiac Climax Phosphate | Am'n Agric'l Chem. Co., N. Y. City | H. M. Rose, Milford | 32.00 | 1 |
| | | J. P. Lathrop, Plainfield | 28.00 | |
| | | | **30.00** | |
| Essex A 1 Superphosphate | Russia Cement Co., Gloucester, Mass. | F. F. Hitchcock, Woodbury | **28.00** | 1 |
| Bowker's Sure Crop Phosphate | Bowker Fertilizer Co., N. Y. City | J. F. Silliman & Co., New Canaan | 30.00 | 1 |
| | | A. R. Manning, Yantic | 29.00 | |
| | | | **29.50** | |
| Chittenden's Soluble Bone and Potash | National Fertilizer Co., Bridgeport | H. A. Bugbee, Willimantic | **26.00** | 1 |
| Bowker's Potash Bone | Bowker Fertilizer Co., N. Y. City | Ansonia Flour & Grain Co., Ansonia | **27.00** | 1 |
| | | J. F. Silliman & Co., New Canaan | 27.00 | |
| Bradley's Niagara Phosphate | Am'n Agric'l Chem. Co., N. Y. City | Platt Bros., Milford | 27.00 | 1 |
| | | A. H. Cashen, Meriden | 24.00 | |
| | | | **25.50** | |
| Coe's Ground Bone & Potash | Coe-Mortimer Co., N. Y. City | Atwater Bros., New Haven | ...... | 2 |
| *Sampled by purchasers and others.* | | *Sent by* | | |
| Conn. Valley Orchard Co.'s H. G. Fertilizer | Conn. Valley Orchard Co., Berlin, Conn. | G. W. Spicer, Deep River | **27.00** | 2 |
| Conn. Valley Orchard Co.'s H. G. Fertilizer | Conn. Valley Orchard Co., Berlin, Conn. | J. L. Watrous, Meriden | **28.00** | 2 |
| James' Bone Phosphate | Ernest L. James, Warrenville | Manufacturer | **30.00** | 2 |
| Lister's Ammoniated Dissolved Bone | Lister's Agric'l Chem. Works, Newark, N. J. | Lister Agric'l Chem. Works, Newark, N. J. | ...... | 1 |
| Manchester's Formula | E. Manchester & Sons, [illegible] | [illegible] | | |

## ANALYSES AND VALUATIONS—*Concluded.*

| Percentage difference between cost and valuation. | Nitrogen. As Nitrates. | As Ammonia. | Organic. | Total Nitrogen. Found. | Total Nitrogen. Guaranteed. | Phosphoric Acid. Water-soluble. | Citrate-soluble. | Citrate-insoluble. | Total. Found. | Total. Guaranteed. | So-called "Available." Found. | So-called "Available." Guaranteed. | Potash. Found. As Muriate. | Potash. Found. Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 89.9 | ---- | --- | 1.06 | 1.06 | **0.8** | 7.44 | 1.33 | 1.85 | 10.62 | **9.0** | 8.77 | **8.0** | 3.98 | 3.98 |
| 90.4 | ---- | --- | --- | ---- | --- | 6.66 | 3.77 | 0.52 | 10.95 | **11.0** | 10.43 | **10.0** | 2.13 | 2.13 |
| 94.2 | ---- | --- | 1.25 | 1.25 | **1.0** | 5.81 | 3.05 | 1.83 | 10.69 | **9.0** | 8.86 | **8.0** | 2.24 | 2.24 |
| 99.5 | ---- | --- | 1.38 | 1.38 | **1.2** | 6.05 | 2.55 | 1.17 | 9.77 | **8.0** | 8.60 | **7.0** | 2.02 | 2.02 |
| 102.7 | 0.05 | --- | 1.19 | 1.24 | **1.0** | 6.50 | 2.34 | 1.27 | 10.11 | **9.0** | 8.84 | **8.0** | 2.35 | 2.35 |
| 107.4 | ---- | --- | 1.20 | 1.20 | **1.0** | 2.05 | 4.71 | 4.15 | 10.91 | **9.0** | 6.76 | **7.0** | 2.09 | 2.09 |
| 111.5 | ---- | --- | 0.93 | 0.93 | **0.8** | 6.88 | 2.20 | 1.67 | 10.75 | **9.0** | 9.08 | **7.0** | 2.22 | 2.22 |
| 114.2 | ---- | --- | --- | ---- | --- | 3.44 | 7.05 | 3.54 | 14.03 | **12.0** | 10.49 | **11.0** | 2.33 | 2.33 |
| 118.1 | ---- | --- | 0.96 | 0.96 | **0.8** | 5.50 | 1.76 | 1.11 | 8.37 | **7.0** | 7.26 | **6.0** | 2.39 | 2.39 |
| 126.5 | ---- | --- | 0.94 | 0.94 | **0.8** | 4.08 | 2.45 | 2.74 | 9.27 | **8.0** | 6.53 | **7.0** | 1.24 | 1.24 |
| ---- | ---- | --- | 1.48 | 1.48 | **2.0** | 0.27 | 13.86 | 10.01 | 24.14 | ---- | 14.13 | --- | 2.02 | 2.02 |
| 19.6 | 0.40 | 0.64 | 1.66 | 2.70 | **2.5** | 7.81 | 2.14 | 1.13 | 11.08 | **11.0** | 9.95 | **9.0** | 4.33 | 4.33 |
| 23.3 | 0.59 | 0.36 | 1.59 | 2.54 | **2.5** | 9.36 | 1.52 | 0.95 | 11.83 | **11.0** | 10.88 | **9.0** | 4.34 | 4.24 |
| 37.9 | ---- | --- | 2.18 | 2.18 | --- | 2.34 | 8.32 | 2.87 | 13.53 | ---- | 10.66 | ---- | 4.42 | 4.42 |
| ---- | 0.61 | --- | 1.49 | 2.10 | **2.1** | 3.68 | 5.15 | 1.92 | 10.75 | **9.0** | 8.83 | **8.0** | 1.84 | 1.84 |
| ---- | 1.35 | --- | 1.07 | [illegible] | [illegible] | 2.25 | 4.01 | 2.02 | 10.18 | **9.0** | 8.16 | ---- | 8.05 | 8.05 |

## SPECIAL MANURES.

Here are included such mixed fertilizers, chiefly nitrogenous superphosphates, as are claimed by their manufacturers to be specially adapted to the needs of particular crops. Those which are claimed to contain potash in form of carbonate are separately discussed on pages 88 to 93.

### 1. *Samples Drawn by Station Agent.*

In the table on pages 70-89 are given analyses of one hundred and twenty-three brands represented by samples drawn by the station agents.

### *Special Manures Requiring Special Notice.*

The manufacturer objected to the analysis of Shay's Potato Manure, **16554**, given on pages 70 and 71, because the percentages of nitrogen and potash were much lower and that of phosphoric acid much higher than they should be or than was shown by the factory tests and asked that another sample be tested. This was done and the analysis **16720** is given on the pages above cited.

This second analysis shows a higher percentage of nitrogen and a much lower percentage of phosphoric acid than the first sample.

The manufacturer objected to the analysis of **16443**, Hubbard's Soluble Potato Manure, given on pages 72 and 73, because of the slight shortage of nitrogen and excess of potash which might be charged to an error of sampling and asked for the analysis of another sample. This second analysis, **16581**, pages 72 and 73, shows a greater deficiency of nitrogen and a larger excess of potash than the first analysis.

The same objection was made to the analysis of **16442**, Hubbard's Potato Phosphate, given on pages 78 and 79.

The analysis of a second sample, **16614**, pages 78 and 79, showed more nitrogen and much less potash than the first sample.

**16788** is a Special Tobacco Manure made by the Bowker Fertilizer Co. on a formula furnished by Herman Ude, Suffield.

ANALYSIS.

| | 16788 |
|---|---|
| Nitrogen as nitrates | 0.92 |
| " organic | 3.02 |
| " total | 3.94 |
| Water-soluble phosphoric acid | 2.48 |
| Citrate-soluble " " | 2.66 |
| Citrate-insoluble " " | 0.76 |
| Total " " | 5.90 |
| Potash calculated as muriate | 8.39 |
| " " " sulphate | 1.69 |
| " total, water-soluble | 10.08 |
| Chlorine | 6.31 |
| Sulphuric acid | 12.40 |
| Cost per ton | $38.00 |
| Valuation | 27.69 |

GUARANTIES.

Of the one hundred and twenty-three fertilizers in the following tables, thirty-eight, or more than one-fourth of the whole number, fail to meet the maker's minimum guaranty in respect of one or more ingredients. Twelve are deficient in nitrogen alone, one in citrate-soluble phosphoric acid and twenty-one in potash. Three others are below the minimum guaranty in respect of two ingredients and one in respect of all three.

In all but three cases however a deficiency in one ingredient is made good by an excess of another, so that it may fairly be said that the analysis shows a commercial equivalent for the claims of the guaranty.

16554. Shay's Potato Manure shows a slight deficiency in the commercial equivalent, but a second analysis (16720) of the same brand does not show it.

17882. Chittenden's Excelsior Potato Fertilizer. Nitrogen found 2.90, guaranteed 3.3. Citrate-soluble phosphate acid found 4.57, guaranteed 6.0.

16498. Buffalo Fertilizer Co.'s Vegetable and Potato shows nitrogen found 1.76 per cent., guaranteed 2.5. Phosphoric acid found 8.78, guaranteed 9.0. Potash found 5.91, guaranteed 7.0. Here the commercial equivalent of the guaranty is by no means made good by the analysis.

COST AND VALUATION.

The method of ascertaining the retail cash cost price of the special manures and of computing the valuation is the same as described on page 39.

The average cost per ton of the one hundred and twenty-one manures, the cost and valuation of which are given in the tables,

was $34.28, the valuation $23.70 and the percentage difference 44.6.

In 1905 the corresponding figures were: Average cost, $33.99; valuation, $23.92; percentage difference, 41.8.

The average composition and cost of special manures for the last five years, excluding those guaranteed to contain potash as carbonate, have been as follows:

PERCENTAGE COMPOSITION.

| Year. | Nitrogen. | Total phosphoric acid. | Potash. | Cost per ton. |
|---|---|---|---|---|
| 1906 | 2.99 | 9.98 | 5.92 | $34.28 |
| 1905 | 2.93 | 10.38 | 6.13 | 33.99 |
| 1904 | 2.92 | 8.56 | 5.92 | 33.93 |
| 1903 | 3.03 | 8.00* | 6.32 | 33.30 |
| 1902 | 3.03 | 8.17* | 6.08 | 33.35 |
| 1901 | 2.87 | 8.88* | 6.44 | 32.64 |

Without regarding the station's valuations, but considering only the retail price of the different brands and their actual composition, it appears that the following amounts of nitrogen, phosphoric acid and potash have been purchasable for $30.00 in the different groups of special manures:

PURCHASABLE FOR THIRTY DOLLARS.

| | Nitrogen, pounds. | Phosphoric acid, pounds. | Potash, pounds. | Cost per ton. |
|---|---|---|---|---|
| In the first 16 analyses in the table | 69 | 170 | 143 | $36.50 |
| " next 12 " " " | 67 | 163 | 124 | 39.38 |
| " " 16 " " " | 62 | 155 | 114 | 36.06 |
| " " 12 " " " | 60 | 161 | 98 | 35.21 |
| " " 13 " " " | 47 | 174 | 112 | 33.73 |
| " " 13 " " " | 48 | 199 | 90 | 31.61 |
| " " 12 " " " | 39 | 198 | 83 | 31.25 |
| " " 12 " " " | 37 | 190 | 79 | 31.81 |
| " " 15 " " " | 32 | 174 | 66 | 32.37 |

The lessons of these figures are the same as those of the nitrogenous superphosphates.

For one thing the system of valuation used by this station is proved to be useful and accurate *for the purpose for which it is designed,* which is to grade fertilizers according to the

* "Available" phosphoric acid.

cost to the farmer of the actual plant food contained in them. For instance: the above table shows that when the special manures are arranged according to the percentage differences between their costs and valuations—as they are always arranged in these reports—those special manures which are first in the table supply 69 pounds of nitrogen, 170 pounds of phosphoric acid and 143 pounds of potash for $30.00.

Those which stand near the middle of the table supply 47, 174 and 112 pounds of these ingredients, respectively, while those specials which the station puts near the foot of its tables of analyses supply only 32 pounds of nitrogen, 174 of phosphoric acid and 66 of potash for the same amount of money.

The prices of factory-mixed goods bear no close and uniform relation to their content of fertilizing elements and the "cheapest," i. e. the low-priced, are in many cases the most expensive.

Thus in one group of fertilizers selling at an average price of $36.50 the buyer gets, *per dollar paid*, more than twice as much nitrogen and potash and as much phosphoric acid as in another group costing four dollars less per ton.

To this it has been objected that these comparisons and valuations assume that the nitrogen of the different mixed fertilizers is all in quickly available forms; that it is quite possible for the manufacturer without detection to put in inferior or worthless forms of nitrogen which are very cheap and will raise his valuation and it is freely asserted that this is sometimes done. Of course the only perfect protection against such imposition is the purchase of raw materials, which can be more easily examined as to the quality of their nitrogen, and the home mixture of fertilizers.

But assuming that some mixed fertilizers contain inferior forms of nitrogen, it is fair to suppose that the low grade and low-priced goods will be more likely to contain such a mixture than the more costly brands.

### 2. *Sampled by Individuals.*

The table, pages 88 and 89, contains nine analyses of special manures sent by purchasers.

## SPECIAL MANURES.

| | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. |
|---|---|---|---|---|
| | I. *Sampled by Station Agent:* | | | |
| 6 | Baker's East India Complete Potato Manure | American Agricultural Chemical Co., N. Y. | F. J. Hartz, R. F. D., South Manchester | $32.00 |
| 4* | Shay's Potato Manure | The C. M. Shay Fertilizer Co., Groton | Manufacturer | 30.00 |
| 6 | High Grade Grass and Grain Fertilizer | The Rogers Mfg. Co., Rockfall | Manufacturer | 40.00 |
| | | | A. A. Blakeslee, Wallingford | 40.00 |
| 7 | Special Mixture for Seed & Potato Crops | The E. B. Clark Co., Milford | Manufacturer | 28.00 |
| 3 | High Grade Soluble Tobacco Manure | The Rogers Mfg. Co., Rockfall | R. A. Hardin, Glastonbury | ...... |
| | | | Arthur Sikes, Suffield | 43.00 |
| 0* | Shay's Potato Manure | The C. M. Shay Fertilizer Co., Groton | Manufacturer | 30.00 |
| 5 | Mapes' Seeding Down Manure | Mapes F. & P. G. Co., N. Y. | Mapes' Branch, Hartford | 40.00 |
| 6 | H. G. Tobacco Manure | American Agricultural Chemical Co., N. Y. | E. N. Austin, Suffield | 43.00 |
| 7 | Essex Special Tobacco Manure | Russia Cement Co., Gloucester, Mass. | H. C. Aborn & Son,† Ellington | 44.00 |
| | | | Broad Brook Lumber Co., Broad Brook | 44.00 |
| 4 | H. G. Fertilizer for Oats & Top Dress'g | The Rogers Mfg. Co., Rockfall | Arthur Sikes, Suffield | 44.00 |
| | | | A. A. Blakeslee, Wallingford | 44.00 |
| [illegible] | Shay's Grass Fertilizer | The C. M. Shay Fertilizer Co., Groton | Manufacturer | 35.00 |
| [illegible] | Shay's Corn Manure | The C. M. Shay Fertilizer Co., Groton | Manufacturer | 26.00 |
| [illegible] | Home Mixture for Corn and Potatoes | Olds & Whipple, Hartford | Manufacturer | 32.00 |
| 4 | Chittenden's H. G. Special Tobacco Fertilizer | Nation'l Fertilizer Co., Bridgeport | J. N. Lasbury, Broad Brook | 44.00 |
| 3 | Berkshire Tobacco Special | Berkshire Fertilizer Co., Bridgeport | O. S. Wood, Ellington | 34.00 |
| 2 | H. G. Soluble Tobacco and Potato Manure | The Rogers Mfg. Co., Rockfall | Arthur Sikes, Suffield | 39.00 |
| | | | A. A. Blakeslee, Wallingford | 39.00 |
| : | Swift-Sure Superphosphate for Potatoes | M. L. Shoemaker & Co., Philadelphia, Pa. | F. H. Rolf, Guilford | 33.00 |

## Analyses and Valuations.

| | Percentage difference between cost and valuation. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Total Nitrogen. | | | | | Total. | | So-called "Available." | | Found. | |
| | | As Nitrates. | As Ammonia. | Organic. | Found. | Guaranteed. | Water-soluble. | Citrate-soluble. | Citrate-insoluble. | Found. | Guaranteed. | Found. | Guaranteed. | As Muriate. | Total. |
| 5 | 12.4 | 0.80 | 0.24 | 2.48 | 3.52 | **3.3** | 3.76 | 3.35 | 1.79 | 8.90 | **7.0** | 7.11 | **6.0** | 10.62 | 10.6 |
| 4 | 12.4 | 0.64 | --- | 2.42 | 3.06 | **3.5** | 3.70 | 7.19 | 3.44 | 14.33 | **9.0** | 10.89 | ---- | 4.93 | 5.9 |
| 5 | 13.2 | 0.21 | --- | 2.93 | 3.14 | **3.0** | trace | 13.12 | 5.80 | 18.92 | **16.0** | 13.12 | ---- | 12.93 | 12.9 |
| 7 | 14.4 | 0.83 | 0.12 | 2.23 | 3.18 | **3.3** | 6.21 | 1.40 | 0.58 | 8.19 | **8.0** | 7.61 | ---- | 7.20 | 7.2 |
| 3 | 14.9 | 2.08 | --- | 3.14 | 5.22 | **5.0** | 2.16 | 6.24 | 0.95 | 9.35 | **8.0** | 8.40 | **6.0** | 1.41 | 11.8 |
| | 17.2 | 0.35 | --- | 3.01 | 3.36 | **3.5** | 4.82 | 4.30 | 0.39 | 9.51 | **9.0** | 9.12 | ---- | 6.31 | 6.3 |
| | 18.6 | 2.42 | 0.14 | 0.28 | 2.84 | **2.5** | 0.13 | 15.26 | 2.69 | 18.08 | **18.0** | 15.39 | ---- | 12.71 | 12.7 |
| | 18.7 | --- | 3.37 | 2.57 | 5.94 | **5.7** | 4.96 | 1.19 | 0.73 | 6.88 | **6.0** | 6.15 | **5.0** | 1.18 | 9.4 |
| 7 | 19.2 | 1.80 | --- | 2.77 | 4.57 | **4.5** | 5.41 | 3.08 | 2.52 | 11.01 | **7.5** | 8.49 | **5.5** | 0.92 | 12.5 |
| 4 | 19.6 | 4.67 | 0.18 | 1.97 | 6.82 | **6.3** | 1.71 | 6.31 | 1.11 | 9.13 | **9.0** | 8.02 | **7.0** | 7.56 | 7.5 |
| | 20.4 | 0.77 | 0.24 | 3.15 | 4.16 | **4.0** | 4.42 | 5.41 | 0.65 | 10.48 | **9.0** | 9.83 | ---- | 6.16 | 6.3 |
| | 21.5 | --- | 0.18 | 2.36 | 2.54 | **2.0** | 5.04 | 3.84 | 0.36 | 9.24 | **8.0** | 8.88 | ---- | 5.05 | 5.0 |
| | 22.4 | --- | 0.93 | 2.92 | 3.85 | **3.3** | 0.26 | 7.11 | 0.73 | 8.10 | ---- | 7.37 | **7.0** | 1.33 | 6.0 |
| | 23.2 | --- | 2.33 | 3.39 | 5.72 | **5.7** | 4.69 | 1.12 | 0.38 | 6.19 | **7.0** | 5.81 | **5.0** | 0.80 | 9.8 |
| | 23.3 | --- | 0.61 | 4.01 | 4.62 | **4.1** | 1.84 | 4.24 | 1.47 | 7.55 | **4.0** | 6.08 | **3.0** | 1.14 | 5.1 |
| | 23.7 | 1.51 | --- | 2.37 | 3.88 | **3.5** | 2.14 | 6.54 | 1.40 | 10.08 | **9.0** | 8.68 | **7.0** | 1.36 | 10.2 |
| | 23.9 | 0.41 | --- | 2.39 | 2.80 | **2.9** | 6.90 | 3.79 | 0.86 | 11.55 | ---- | 10.69 | ---- | 8.07 | 8.0 |

## SPECIAL MANURES.

| Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. |
|---|---|---|---|
| 1. *Sampled by Station Agent:* | | | |
| Essex Complete Manure for Potatoes, Roots & Vegetables | Russia Cement Co., Gloucester, Mass. | W. J. Cox, East Hartford | $39.00 |
| | | Spencer Bros., Suffield | 41.00 |
| | | | 40.00 |
| Complete Corn and Onion Manure | The Rogers Mfg. Co., Rockfall | R. E. Davis, Guilford | 33.00 |
| | | Arthur Sikes, Suffield | 35.00 |
| | | | 34.00 |
| Stockbridge Tobacco Manure | Bowker Fertilizer Co., N. Y. | Jos. Thrall,† Windsor | 46.00 |
| * Hubbard's Soluble Potato Manure | The Rogers & Hubbard Co., Middletown | City Coal & Wood Co., New Britain | 40.00 |
| | | H. W. Andrews, Wallingford | 40.00 |
| Hubbard's Grass and Grain Fertilizer | The Rogers & Hubbard Co., Middletown | City Coal & Wood Co., New Britain | 41.00 |
| | | J. M. Page & Co., Naugatuck | 38.00 |
| | | | 39.50 |
| Hubbard's Oats and Top Dressing | The Rogers & Hubbard Co., Middletown | W. C. Bulkley, Forestville | 54.00 |
| | | H. W. Andrews, Wallingford | 52.00 |
| | | | 53.00 |
| Wilcox' Grass Fertilizer | Wilcox Fertilizer Works, Mystic | Spencer Bros., Suffield | 35.00 |
| | | Manufacturer | 34.50 |
| * Hubbard's Soluble Potato Manure | The Rogers & Hubbard Co., Middletown | C. H. Wheeler, East Canaan | 41.00 |
| | | | 40.00 |
| Hubbard's Soluble Tobacco Manure | The Rogers & Hubbard Co., Middletown | H. W. Andrews, Wallingford | 46.00 |
| | | City Coal & Wood Co., New Britain | 47.00 |
| | | | 46.50 |
| Swift's Lowell Special Grass Mixture | Swift's Lowell Fertilizer Co., Boston, Mass. | Weed & Turner, New Canaan | 40.00 |
| | | Strong & Tanner, Winsted | 38.00 |
| | | | 39.00 |
| Essex Grass and Top Dressing Fertilizer | Russia Cement Co., Gloucester, Mass. | Spencer Bros., Suffield | 44.00 |
| Bradley's Complete Manure for Top Dressing Grass and Grain | American Agricultural Chemical Co., N. Y. | C. Buckingham, Southport | 34.00 |
| | | Chas. H. Rounds, North Sterling | 37.00 |

## Analyses and Valuations—*Continued.*

| | Percentage difference between cost and valuation. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potas | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | As Nitrates. | As Ammonia. | Organic. | Total Nitrogen. | | Water-soluble. | Citrate-soluble. | Citrate-insoluble. | Total. | | So-called "Available." | | Found. | |
| | | | | | Found. | Guaranteed. | | | | Found. | Guaranteed. | Found. | Guaranteed. | As Muriate. | Total. |
| 5 | 25.1 | 0.73 | 0.08 | 3.01 | 3.82 | 3.7 | 5.44 | 4.32 | 3.15 | 12.91 | 9.0 | 9.76 | 7.0 | 0.88 | 8.6 |
| ) | 26.0 | 1.63 | ... | 2.11 | 3.74 | 3.6 | 4.38 | 3.93 | 1.21 | 9.52 | 8.0 | 8.31 | 6.0 | 7.34 | 7.3 |
| t | 26.1 | 0.22 | 2.12 | 3.68 | 6.02 | 5.8 | 1.84 | 3.75 | 1.06 | 6.65 | 5.0 | 5.59 | 4.0 | 1.08 | 9.8 |
| 3 | 26.1 | 2.18 | 0.30 | 2.34 | 4.82 | 5.0 | 0.88 | 9.49 | 2.33 | 12.70 | 10.0 | 10.37 | 7.0 | 1.82 | 5.7 |
| 4 | 26.2 | 0.05 | ... | 2.77 | 2.82 | 2.3 | 0.22 | 9.34 | 6.02 | 15.58 | 16.0 | 9.56 | 6.6 | 12.71 | 12.7 |
| 4 | 26.5 | 6.98 | ... | 1.04 | 8.02 | 8.5 | 0.08 | 7.24 | 2.07 | 9.39 | 8.0 | 7.32 | 3.9 | 9.80 | 9.8 |
| 3 | 26.6 | 1.86 | 0.24 | 2.16 | 4.26 | 4.1 | 5.47 | 2.82 | 0.61 | 8.90 | 7.0 | 8.29 | 6.0 | 5.73 | 5.7 |
| t | 26.9 | 2.54 | 0.33 | 1.73 | 4.60 | 5.0 | 0.82 | 8.47 | 1.47 | 10.76 | 10.0 | 9.29 | 7.0 | 2.06 | 7.7 |
| 5 | 27.1 | 2.28 | 0.22 | 2.56 | 5.06 | 5.0 | 0.82 | 9.23 | 2.36 | 12.41 | 10.0 | 10.05 | 7.0 | 0.82 | 9.8 |
| ) | 29.2 | ... | 1.32 | 2.89 | 4.21 | 4.1 | 4.50 | 5.58 | 1.33 | 11.41 | 8.0 | 10.08 | 7.0 | 1.77 | 6.1 |
| ) | 29.5 | 3.28 | ... | 1.95 | 5.23 | 5.0 | 5.02 | 5.02 | 1.83 | 11.87 | 10.0 | 10.04 | ... | 7.85 | 7.8 |
| ) | 30.6 | 3.36 | 0.36 | 1.52 | 5.24 | 4.9 | 2.40 | 3.53 | 1.00 | 6.93 | 6.0 | 5.93 | 5.0 | 4.51 | 4.5 |

## SPECIAL MANURES.

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. |
|---|---|---|---|---|
| | 1. *Sampled by Station Agent:* | | | |
| 757 | Bowker's Fairfield Onion Fertilizer | Bowker Fertilizer Co., N. Y. | B. F. Pease, Fairfield | $33. |
| 705 | Wheeler's Havana Tobacco Grower | American Agricultural Chemical Co., N. Y. | F. M. Loomis, Granby | . . |
| | | | | 35. |
| 435 | Essex Complete Manure for Corn, Grain and Grass | Russia Cement Co., Gloucester, Mass. | John Parker, Poquonock | 39. |
| | | | W. J. Cox, East Hartford | 39. |
| 98 | Stockbridge Potato & Vegetable Manure | Bowker Fertilizer Co., N. Y. | E. B. Clark Co., Milford | 33. |
| | | | Lightbourn & Pond Co., New Haven | 40. |
| | | | | 36. |
| 528 | Lister's Potato Manure | Lister's Agricultural Chemical Works, Newark, N. J. | A. I. Martin, Wallingford | 36. |
| | | | J. C. Wilcoxson, Stratford | 36. |
| 511 | Olds & Whipple's H. G. Potato Manure | Olds & Whipple, Hartford | Manufacturer | 37. |
| 99 | Mapes' Economical Potato Manure | Mapes F. & P. G. Co., N. Y. | Mapes' Branch, Hartford | 35. |
| | | | A. N. Clark, Milford | 35. |
| 40 | Berkshire Grass Fertilizer | Berkshire Fertilizer Co., Bridgeport | Avery Bros., Norwich Town | 34. |
| 21 | Wilcox' Potato, Onion & Vegetable Manure | Wilcox Fertilizer Works, Mystic | D. O. Coleman, Southington | ---- |
| | | | Olds & Whipple, Hartford | 37. |
| 26 | Special Potato Fertilizer | Parmenter & Polsey Fertilizer Co., Peabody, Mass. | T. J. Pring & Bros., Wallingford | 38. |
| | | | James T. Hill, Suffield | 36. |
| | | | | 37. |
| 58 | Darling's Potato Manure | American Agricultural Chemical Co., N. Y. | A. D. Zabriski, Norwich | 32. |
| 89 | Special Grass & Grain | Coe-Mortimer Co., N. Y. | A. L. Burdick, Westbrook | 25. |
| 92 | Bowker's Early Potato Manure | Bowker Fertilizer Co., N. Y. | W. T. McKenzie, Yalesville | 38. |
| | | | Bowker's Branch, Hartford | 36. |
| 22 | Sanderson's Formula B for Tobacco | Sanderson Fertilizer & Chemical Co., New Haven | E. S. Stevens, Glastonbury | 33. |
| | | | Manufacturer | 35. |

ANALYSES AND VALUATIONS—*Continued.*

| Percentage difference between cost and valuation. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | As Nitrates. | As Ammonia. | Organic. | Total Nitrogen. | | Water-soluble. | Citrate-soluble. | Citrate-insoluble. | Total. | | So-called "Available." | | Found. | |
| | | | | Found. | Guaranteed. | | | | Found. | Guaranteed. | Found. | Guaranteed. | As Muriate. | Total. |
| 32.1 | --- | 1.18 | 2.22 | 3.40 | **3.0** | 5.60 | 2.79 | 0.90 | 9.29 | **9.0** | 8.39 | **8.0** | 5.90 | 5.90 |
| 32.5 | --- | 0.47 | 2.19 | 2.66 | **2.5** | 5.73 | 1.39 | 0.95 | 8.07 | **7.0** | 7.12 | **6.0** | 0.86 | 10.15 |
| 34.2 | 0.76 | --- | 2.32 | 3.08 | **3.3** | 7.41 | 3.27 | 0.45 | 11.13 | **9.5** | 10.68 | **7.0** | 10.00 | 10.00 |
| 35.8 | 0.41 | 0.68 | 2.21 | 3.30 | **3.3** | 4.74 | 1.94 | 0.82 | 7.50 | **7.0** | 6.68 | **6.0** | 10.37 | 10.37 |
| 36.0 | 0.89 | 0.54 | 1.91 | 3.34 | **3.3** | 4.21 | 4.85 | 2.04 | 11.10 | **9.0** | 9.06 | **8.0** | 7.15 | 7.15 |
| 36.2 | --- | 0.59 | 3.04 | 3.63 | **3.3** | 0.37 | 5.82 | 0.68 | 6.87 | ---- | 6.19 | **6.0** | 10.10 | 10.1 |
| 36.4 | 2.38 | 0.39 | 0.71 | 3.48 | **3.3** | 1.98 | 4.01 | 1.05 | 7.04 | **6.0** | 5.99 | **4.0** | 1.94 | 8.6 |
| 36.8 | 3.16 | --- | 1.78 | 4.94 | **5.0** | 1.73 | 3.51 | 2.51 | 7.75 | **5.0** | 5.24 | **4.0** | 2.90 | 2.9 |
| 37.1 | 1.00 | 0.28 | 2.24 | 3.52 | **3.3** | 6.24 | 2.96 | 0.54 | 9.74 | **8.0** | 9.20 | **7.0** | 4.75 | 6.9 |
| 37.2 | 0.71 | --- | 2.46 | 3.17 | **3.3** | 5.76 | 4.46 | 1.34 | 11.56 | **9.0** | 10.22 | **8.0** | 7.34 | 7.3 |
| 38.5 | 0.12 | --- | 2.70 | 2.82 | **2.5** | 4.80 | 3.59 | 1.84 | 10.23 | **9.0** | 8.39 | **6.0** | 5.63 | 5.6 |
| 38.8 | 0.19 | 0.38 | 1.26 | 1.83 | **1.0** | 6.92 | 1.99 | 1.32 | 10.23 | **10.0** | 8.91 | **8.5** | 0.89 | 3.1 |
| 39.4 | 0.71 | 0.65 | 2.19 | 3.55 | **3.3** | 5.15 | 2.25 | 0.92 | 8.32 | **8.0** | 7.40 | **7.0** | 7.40 | 7.4 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | **10.0** | 8.00 | **6.0** | 1.89 | 5.8 |

## Special Manures.

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. |
|---|---|---|---|---|
| | 1. *Sampled by Station Agent:* | | | |
| 55 | Northwestern 10% Potato Fertilizer | Northwestern Mfg. Co., Chicago, Ill. | S. T. Welden, Simsbury | $33.0 |
| | | | Strong & Tanner, Winsted | 35.0 |
| | | | J. G. Schwink, Meriden | 35.5 |
| | | | | 34.5 |
| 30 | Stockbridge Grass Top Dressing | Bowker Fertilizer Co., N. Y. | W. H. Scott, Pequabuck | 40.0 |
| | | | Bowker's Branch, Hartford | 38.0 |
| 06 | Wilcox' Potato Fertilizer | Wilcox Fertilizer Works, Mystic | Spencer Bros., Suffield | 29.0 |
| | | | Manufacturer | 27.5 |
| 97 | Mapes' Potato Manure | Mapes F. & P. G. Co., N. Y. | Mapes' Branch, Hartford | 38.0 |
| | | | A. N. Clark, Milford | 38.0 |
| | | | J. H. Barker, Branford | 38.0 |
| 73 | Packers' Union Potato Manure | American Agricultural Chemical Co., N. Y. | F. L. Mackey, Ellington | 31.0 |
| | | | G. A. Forsyth, Waterford | 32.0 |
| | | | | 31.5 |
| 63 | Tobacco Starter and Grower | American Agricultural Chemical Co., N. Y. | C. M. Beach, New Milford | 36.0 |
| 98 | Mapes' Tobacco Starter, Improved | Mapes F. & P. G. Co., N. Y. | Southington Lumber Co., Southington | 36.0 |
| | | | Mapes' Branch, Hartford | 35.0 |
| 38 | Stockbridge Corn Manure | Bowker Fertilizer Co., N. Y. | E. B. Clark Co., Milford | 33.0 |
| | | | Bowker's Branch, Hartford | 38.0 |
| 50 | Tobacco Starter | The Rogers Mfg. Co., Rockfall | Manufacturer | 35.0 |
| | | | Patrick Manning,* Thompsonville | 35.0 |
| 4 | Complete Potato and Vegetable | The Rogers Mfg. Co., Rockfall | R. A. Hardin, Glastonbury | ---- |
| | | | R. E Davis, Guilford | 31.0 |
| 2 | Home Mixture for Grass | Olds & Whipple, Hartford | Manufacturer | 34.0 |
| 9 | Quinnipiac Potato Manure | American Agricultural Chemical Co., N. Y. | C. Buckingham, Southport | 28.0 |
| | | | G. M. Williams Co., | |

## ANALYSES AND VALUATIONS—*Continued.*

| Percentage difference between cost and valuation. | Nitrogen. As Nitrates. | As Ammonia. | Organic. | Total Nitrogen. Found. | Guaranteed. | Phosphoric Acid. Water-soluble. | Citrate-soluble. | Citrate-insoluble. | Total. Found. | Guaranteed. | So-called "Available." Found. | Guaranteed. | Potash. Found. As Muriate. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40.8 | --- | --- | 1.90 | 1.90 | **1.7** | 7.41 | 2.25 | 1.25 | 10.91 | **9.0** | 9.66 | **8.0** | 10.0 | 10.0 |
| 41.4 | 2.05 | --- | 3.11 | 5.16 | **4.9** | 2.83 | 1.24 | 0.55 | 4.62 | **5.0** | 4.07 | **4.0** | 5.68 | 5.68 |
| 41.6 | 0.40 | 0.26 | 1.58 | 2.24 | **2.1** | 5.47 | 2.26 | 0.46 | 8.19 | **7.0** | 7.73 | ---- | 5.21 | 5.21 |
| 41.6 | 2.72 | 0.42 | 0.54 | 3.68 | **3.7** | 2.77 | 5.61 | 1.42 | 9.80 | **8.0** | 8.38 | **8.0** | 1.88 | 7.12 |
| 41.6 | 0.62 | --- | 1.73 | 2.35 | **2.1** | 6.41 | 2.65 | 2.01 | 11.07 | **10.0** | 9.06 | **8.0** | 6.01 | 6.01 |
| 41.7 | --- | 1.62 | 1.90 | 3.52 | **3.3** | 6.58 | 2.73 | 1.03 | 10.34 | **9.0** | 9.31 | **8.0** | 0.80 | 4.3 |
| 42.5 | 3.18 | 0.48 | 1.11 | 4.77 | **4.1** | 1.22 | 5.96 | 1.84 | 9.02 | **8.0** | 7.18 | **6.0** | 1.37 | 1.8 |
| 42.6 | 0.82 | 1.92 | 0.61 | 3.35 | **3.3** | 7.86 | 2.07 | 1.75 | 11.68 | **11.0** | 9.93 | **10.0** | 6.51 | 6.5 |
| 43.3 | 1.62 | --- | 2.61 | 4.23 | **3.8** | 0.34 | 4.64 | 3.91 | 8.89 | **5.0** | 4.98 | **4.0** | 0.67 | 3.9 |
| 44.5 | 1.06 | --- | 1.39 | 2.45 | **2.3** | 5.84 | 3.13 | 0.94 | 9.91 | **10.0** | 8.97 | **8.0** | 5.51 | 5.[illegible] |
| 44.9 | 0.83 | --- | 2.37 | 3.20 | **3.3** | none | 6.69 | 0.72 | 7.41 | ---- | 6.69 | **6.0** | 0.96 | 6.[illegible] |
| 45.5 | 0.76 | --- | 1.79 | 2.55 | **2.5** | 4.88 | 2.54 | 1.34 | 8.76 | **7.0** | 7.42 | **6.0** | 5.33 | 5.[illegible] |

## SPECIAL MANURES.

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price |
|---|---|---|---|---|
| | 1. *Sampled by Station Agent:* | | | |
| 732 | New England High Grade Potato Fertilizer | New England Fertilizer Co., Boston | J. A. Lewis & Co., Willimantic | $34. |
| 719 | Bradley's Complete Manure for Potatoes and Vegetables | American Agricultural Chemical Co., N. Y. | Avery Bros., Norwich Town | 38. |
| | | | C. M. Beach, New Milford | 39. |
| | | | | **38.** |
| 710 | Special Potato Fertilizer | Nation'l Fertilizer Co., Bridgeport | H. A. Bugbee, Willimantic | 35. |
| 655 | Swift's Special Vegetable Manure | Swift's Lowell Fertilizer Co., Boston, Mass. | J. W. Gardner, Cromwell | 37 |
| | | | Weed & Turner, New Canaan | 40. |
| | | | | **38.** |
| 475 | American Farmers' Corn King | Armour Fertilizer Works, Baltimore, Md. | O. H. Meeker, Danbury | 30. |
| | | | S. V. Osborn, Branford | 32. |
| | | | | **31.** |
| 42* | Hubbard's Potato Phosphate | The Rogers & Hubbard Co., Middletown | E. T. Clark, Milford | 30. |
| | | | H. W. Andrews, Wallingford | 31. |
| 561 | Read's Vegetable and Vine Fertilizer | American Agricultural Chemical Co., N. Y. | G. K. Goodwin, East Canaan | 32. |
| | | | A. H. Cashen, Meriden | 33. |
| | | | | **32.** |
| 21 | Chittenden's Potato Phosphate | Nation'l Fertilizer Co., Bridgeport | J. M. Young, Norwich | 33. |
| | | | H. A. Bugbee, Willimantic | 30. |
| | | | | **31.** |
| 07 | Chittenden's Complete Fertilizer for Tobacco | Nation'l Fertilizer Co., Bridgeport | Latham & Chittenden, Granby | 37. |
| 40 | Swift's Lowell Potato Phosphate | Swift's Lowell Fertilizer Co., Boston, Mass. | Spencer Bros., Suffield | 35. |
| | | | Standard Feed Co., Bridgeport | 34. |
| | | | | **34.** |
| 14* | Hubbard's Potato Phosphate | The Rogers & Hubbard Co., Middletown | Beebe & Bragaw, New London | 32. |
| | | | | **31.0** |
| 48 | Grass & Lawn Top | American Agricultural | G. W. Eaton, Bristol | 38. |

ANALYSES AND VALUATIONS—*Continued.*

| | Percentage difference between cost and valuation. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | As Nitrates. | As Ammonia. | Organic. | *Total* Nitrogen. | | Water-soluble. | Citrate-soluble. | Citrate-*insoluble.* | Total. | | So-called "Available." | | Found. | |
| | | | | | Found. | Guaranteed. | | | | Found. | Guaranteed. | Found. | Guaranteed. | As Muriate. | Total. |
| 32 | 46.2 | --- | --- | 2.46 | 2.46 | 2.5 | 5.68 | 3.63 | 1.10 | 10.41 | 9.0 | 9.31 | 8.0 | 6.72 | 6. |
| 19 | 46.9 | 1.09 | 0.56 | 1.71 | 3.36 | 3.3 | 6.67 | 2.25 | 1.02 | 9.94 | 9.0 | 8.92 | 8.0 | 7.18 | 7.1 |
| 10 | 47.1 | --- | 0.42 | 1.96 | 2.38 | 2.5 | 4.50 | 1.24 | 3.20 | 8.94 | ---- | 5.74 | 5.0 | 10.31 | 10. |
| 55 | 47.8 | 1.00 | --- | 2.20 | 3.20 | 3.3 | 6.02 | 3.54 | 1.62 | 11.18 | 9.0 | 9.56 | 8.0 | 6.70 | 6. |
| 75 | 48.0 | 0.75 | 0.65 | 1.28 | 2.68 | 2.5 | 7.34 | 1.83 | 0.45 | 9.62 | 9.0 | 9.17 | 8.0 | 3.77 | 3. |
| 42 | 48.0 | 0.60 | --- | 1.24 | 1.84 | 2.0 | 7.14 | 3.18 | 0.35 | 10.67 | 10.0 | 10.32 | 9.0 | 6.20 | 6. |
| 61 | 48.6 | 0.20 | --- | 1.97 | 2.17 | 2.1 | 7.09 | 2.19 | 1.26 | 10.54 | 9.0 | 9.28 | 8.0 | 6.22 | 6 |
| 21 | 48.7 | 0.61 | --- | 1.55 | 2.16 | 2.1 | 7.26 | 1.63 | 1.23 | 10.12 | 10.0 | 8.89 | 8.0 | 6.02 | 6 |
| 707 | 49.8 | --- | 1.01 | 2.30 | 3.31 | 3.3 | 7.04 | 1.61 | 0.55 | 9.20 | 10.0 | 8.65 | 8.0 | 0.73 | 4 |
| 440 | *50.1* | --- | *0.16* | *2.26* | *2.42* | 2.5 | 5.47 | 3.80 | *1.42* | *10.69* | 9.0 | *9.27* | 8.0 | *6.50* | [illegible] |
| 614 | *50.2* | *0.41* | --- | *1.59* | 2.00 | 2.0 | 7.23 | 3.95 | *0.42* | *11.60* | 10.0 | *11.18* | *9.0* | 4.19 | [illegible] |
| 548 | 51.2 | 3.52 | --- | 1.24 | 4.76 | 3.9 | 2.14 | 5.15 | 1.29 | 8.58 | 6.0 | 7.29 | 5.0 | 2.76 | [illegible] |

## Special Manures.

| | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. |
|---|---|---|---|---|
| | 1. *Sampled by Station Agent:* | | | |
| 92 | Celebrated Special Potato Fertilizer | Coe-Mortimer Co., N. Y. | A. L. Burdick, Westbrook | $29.00 |
| 94 | Tobacco and Onion Fertilizer | Coe-Mortimer Co., N. Y. | W. L. & S. T. Merwin, Milford | 36.00 |
| 18 | Grass and Oats Fertilizer | American Agricultural Chemical Co., N. Y. | J. H. Paddock, Wallingford | 20.00 |
| | | | Elmer Keeler, Danbury | 25.00 |
| | | | | **20.00** |
| 41 | Mapes' Corn Manure | Mapes F. & P. G. Co., N. Y. | J. H. Barker, Branford | 34.00 |
| | | | Mapes' Branch, Hartford | 34.00 |
| 91 | Williams & Clark's Potato Phosphate | American Agricultural Chemical Co., N. Y. | Collinsville Grain Co., Collinsville | 30.00 |
| | | | Geo. Beaumont, Wallingford | 34.00 |
| | | | | **32.00** |
| 17 | Armour's Fruit and Root Crop Special | Armour Fertilizer Works, Baltimore, Md. | Geo. H. Lowerre, Jr., Jewett City | 27.00 |
| | | | Young Bros. Co., Danielson | 29.00 |
| | | | | **28.00** |
| 53 | Lister's Special 10% Potato | Lister's Agricultural Chemical Works, Newark, N. J. | C. D. Babcock, Jewett City | **37.00** |
| '1 | American Farmers' Complete Potato | Armour Fertilizer Works, Baltimore, Md. | O. H. Meeker, Danbury | 30.00 |
| | | | S. V. Osborn, Branford | 32.00 |
| | | | | **31.00** |
| 6 | Bowker's Tobacco Starter | Bowker Fertilizer Co., N. Y. | Bowker's Branch, Hartford | **33.00** |
| 8 | Packers' Union Animal Corn Fertilizer | American Agricultural Chemical Co., N. Y. | G. A. Forsyth, Waterford | **32.00** |
| 8 | Quinnipiac Potato Phosphate | American Agricultural Chemical Co., N. Y. | C. Buckingham, Southport | 28.00 |
| | | | H. M. Rose, Milford | 34.00 |
| | | | G. M. Williams Co., New London | **30.00** |
| 3 | Great Eastern Vegetable, Vine and Tobacco | American Agricultural Chemical Co., N. Y. | L. J. Goodman, Litchfield | 32.00 |
| | | | J. H. Elliott, Campville | **33.00** |

## ANALYSES AND VALUATIONS—*Continued.*

| | Percentage difference between cost and valuation. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | As Nitrates. | As Ammonia. | Organic. | Total Nitrogen. Found. | Total Nitrogen. Guaranteed. | Water-soluble. | Citrate-soluble. | Citrate insoluble. | Total. Found. | Total. Guaranteed. | So-called "Available." Found. | So-called "Available." Guaranteed. | Found. As Muriate. | Found. Total. |
| | 53.0 | 0.62 | --- | 1.32 | 1.94 | 1.7 | 7.14 | 1.79 | 1.14 | 10.07 | 10.0 | 8.93 | 8.0 | 0.96 | 3.85 |
| | 53.6 | 0.72 | 0.71 | 1.84 | 3.27 | 3.0 | 4.93 | 1.49 | 0.90 | 7.32 | 7.0 | 6.42 | 6.0 | 3.56 | 6.30 |
| | 53.8 | --- | --- | --- | --- | --- | 9.36 | 2.29 | 1.55 | 13.20 | 12.0 | 11.65 | 11.0 | 2.50 | 2.50 |
| | 53.9 | 1.02 | 0.40 | 1.00 | 2.42 | 2.5 | 1.92 | 6.88 | 1.88 | 10.68 | 10.0 | 8.80 | 8.0 | 6.63 | 6.63 |
| | 54.3 | 0.81 | --- | 1.83 | 2.64 | 2.5 | 6.02 | 1.62 | 0.82 | 8.46 | 7.0 | 7.64 | 6.0 | 5.00 | 5.0( |
| 7 | 54.4 | 0.65 | 0.44 | 0.91 | 2.00 | 1.7 | 5.87 | 2.72 | 0.48 | 9.07 | 10.0 | 8.59 | 8.0 | 4.03 | 4.0 |
| 3 | 55.8 | --- | 0.57 | 1.27 | 1.84 | 1.7 | 3.90 | 4.81 | 1.78 | 10.49 | 9.0 | 8.71 | 8.0 | 10.57 | 10.5 |
| 1 | 56.0 | 0.50 | --- | 1.50 | 2.00 | 1.7 | 5.31 | 2.20 | 0.52 | 8.03 | 8.0 | 7.51 | 7.0 | 6.97 | 6.9 |
| 6 | 56.3 | --- | 0.66 | 2.03 | 2.69 | 2.5 | 6.62 | 2.70 | 1.03 | 10.35 | 10.0 | 9.32 | 8.0 | 0.86 | 2.8 |
| 8 | 56.5 | 0.75 | --- | 1.81 | 2.56 | 2.5 | 6.80 | 2.80 | 2.34 | 11.94 | 11.0 | 9.60 | 9.0 | 2.32 | 2.3 |
| 8 | 58.3 | 0.28 | 0.20 | 1.62 | 2.10 | 2.1 | 7.14 | 1.80 | 1.44 | 10.38 | 9.0 | 8.94 | 8.0 | 3.40 | 3.4 |
| 8 | 58.3 | 0.47 | --- | 1.64 | 2.11 | 2.1 | 7.17 | 1.61 | 1.13 | 9.91 | 9.0 | 8.78 | 8.0 | 5.92 | 5.( |

## SPECIAL MANURES.

| | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. |
|---|---|---|---|---|
| | 1. *Sampled by Station Agent:* | | | |
| 5 | Potato Fertilizer | Parmenter & Polsey Fertilizer Co., Peabody, Mass. | Arthur Williams, So. Woodstock | $30.00 |
| | | | T. J. Pring & Bros., Wallingford | 30.00 |
| 0 | Bradley's Potato Fertilizer | American Agricultural Chemical Co., N. Y. | D. L. Clark, Milford | 29.00 |
| | | | John B. Parker, Poquonock | 32.00 |
| | | | | 30.50 |
| 8 | Armour's H. G. Potato | Armour Fertilizer Works, Baltimore, Md. | Lightbourn & Pond, Co., New Haven | 33.00 |
| | | | Edward White, Rockville | 36.00 |
| | | | | 34.50 |
| 5 | Williams & Clark's Potato Manure | American Agricultural Chemical Co., N. Y. | W. H., H. Chappell, R. F. D., Oakdale | 31.00 |
| 4 | Potato and Tobacco Special | Ohio Farmers' Fertilizer Co., Columbus, Ohio | R. A. Sherman, Oneco | 25.00 |
| 6 | Quinnipiac Corn Manure | American Agricultural Chemical Co., N. Y. | G. A. Root & Son, Forestville | 30.00 |
| | | | J. P. Lathrop, Plainfield | 30.00 |
| 4 | Essex Tobacco Starter | Russia Cement Co., Gloucester, Mass. | Spencer Bros., Suffield | 35.00 |
| | | | W. J. Cox, East Hartford | 34.00 |
| | | | | 34.50 |
| 9 | New England Potato Fertilizer | New England Fertilizer Co., Boston, Mass. | M. D. Stanley, New Britain | 33.00 |
| | | | A. T. Camp, Hawleyville | 30.00 |
| | | | | 31.50 |
| 1 | E. Frank Coe's Columbian Corn Fertilizer | Coe-Mortimer Co., N. Y. | John R. Babcock, Mystic | 27.00 |
| 7 | Bradley's Potato Manure | American Agricultural Chemical Co., N. Y. | Spencer Bros., Suffield | 34.00 |
| | | | F. S. Bidwell & Co., Windsor Locks | 34.00 |
| 7 | Bowker's Potato and Vegetable Fertilizer | Bowker Fertilizer Co., N. Y. | B. F. Pease, Fairfield | 30.00 |
| | | | W. T. McKenzie, Yalesville | 36.00 |
| | | | | 34.00 |
| 4 | Berkshire Potato and Vegetable Phosphate | Berkshire Fertilizer Co., Bridgeport | Hotchkiss & Templeton, Waterbury | 32.00 |
| | | | F. C. Benjamin, Dan- | |

## Analyses and Valuations—*Continued.*

| Station No. | Percentage difference between cost and valuation. | Nitrogen. As Nitrates. | As Ammonia. | Organic. | Total Nitrogen. Found. | Guaranteed. | Phosphoric Acid. Water-soluble. | Citrate-soluble. | Citrate-insoluble. | Total. Found. | Guaranteed. | So-called "Available." Found. | Guaranteed. | Pota[sh] Found. As Muriate. | T[otal] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 575 | 59.2 | --- | --- | 1.82 | 1.82 | 1.7 | 4.56 | 3.16 | 1.18 | 8.90 | 7.0 | 7.72 | ---- | 5.91 | 5. |
| 160 | 59.6 | --- | 0.32 | 1.82 | 2.14 | 2.1 | 6.75 | 2.10 | 1.50 | 10.35 | 9.0 | 8.85 | 8.0 | 3.41 | 3. |
| 718 | 60.3 | 0.35 | --- | 1.33 | 1.68 | 1.6 | 6.26 | 2.66 | 0.52 | 9.44 | 10.0 | 8.92 | 8.0 | 8.79 | 8. |
| 775 | 60.5 | --- | 0.84 | 1.32 | 2.16 | 2.1 | 7.52 | 1.57 | 1.29 | 10.38 | 9.0 | 9.09 | 8.0 | 3.46 | 3. |
| 754 | 61.0 | --- | --- | 1.16 | 1.16 | 1.6 | 2.24 | 6.56 | 2.38 | 11.18 | 8.0 | 8.80 | 6.0 | 3.55 | 3. |
| 576 | 61.3 | 0.15 | --- | 2.17 | 2.32 | 2.1 | 6.32 | 2.71 | 1.55 | 10.58 | 9.0 | 9.03 | 8.0 | 1.87 | 1. |
| 404 | 62.2 | 1.45 | --- | 0.95 | 2.40 | 2.5 | 6.48 | 2.94 | 5.07 | 14.49 | 12.0 | 9.42 | ---- | 0.48 | 2. |
| 199 | 65.0 | --- | --- | 2.02 | 2.02 | 1.6 | 5.94 | 2.63 | 1.45 | 10.02 | 8.0 | 8.57 | 7.0 | 4.22 | 4. |
| 91 | 65.2 | 0.41 | --- | 1.01 | 1.42 | 1.2 | 6.88 | 2.31 | 1.48 | 10.67 | 10.0 | 9.19 | 7.5 | 0.48 | 2. |
| 77 | 65.5 | 0.54 | --- | 2.18 | 2.72 | 2.5 | 4.90 | 2.12 | 0.89 | 7.91 | 7.0 | 7.02 | 6.0 | 4.98 | 4. |
| 57 | 65.7 | --- | --- | 2.43 | 2.43 | 2.5 | 4.03 | 4.59 | 1.47 | 10.09 | 9.0 | 8.62 | 8.0 | 4.27 | 4. |
| 74 | 67.0 | --- | --- | 2.00 | 2.00 | 1.7 | 4.82 | 3.06 | 0.50 | 8.38 | 8.0 | 7.88 | 6.0 | 4.90 | 4. |

## Special Manures

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. |
|---|---|---|---|---|
| | 1. *Sampled by Station Agent:* | | | |
| 557 | Crocker's Ammoniated Corn Phosphate | American Agricultural Chemical Co., N. Y. | F. M. Loomis, Granby | ..... |
| | | | C. H. Wheeler, East Canaan | $30.0 |
| 578 | Sanderson's Corn Superphosphate | Sanderson Fertilizer & Chemical Co., New Haven | Dr. J. L. Buel,* Litchfield | 28.0 |
| | | | E. H. Wilcox, Winsted | ..... |
| 741 | Great Eastern Northern Corn Special | American Agricultural Chemical Co., N. Y. | Elmer Keeler, Danbury | 34.0 |
| 556 | Crocker's Potato, Hop and Tobacco | American Agricultural Chemical Co., N. Y. | H. A. Welton, Thomaston | 32.0 |
| | | | F. M. Loomis, Granby | 31.0 |
| | | | | 31.5 |
| 545 | Essex Corn Fertilizer | Russia Cement Co., Gloucester, Mass. | J. & H. Woodford, Avon | 33.0 |
| | | | John B. Parker, Poquonock | 34.0 |
| | | | | 33.5 |
| 562 | Williams & Clark's Corn Phosphate | American Agricultural Chemical Co., N. Y. | Collinsville Grain Co., Collinsville | 30.0 |
| | | | Platt Bros., Milford | 32.5 |
| | | | | 31.2 |
| 795 | E. Frank Coe's New Englander Corn Fertilizer | Coe-Mortimer Co., N. Y. | W. E. Warner & Bro., Westville | 28.0 |
| 495 | Essex Market Garden & Potato Manure | Russia Cement Co., Gloucester, Mass. | W. J. Cox, East Hartford | 34.0 |
| | | | John B. Parker, Poquonock | 35.0 |
| | | | | 34.5 |
| 544 | Swift's Lowell Potato Manure | Swift's Lowell Fertilizer Co., Boston, Mass. | Standard Feed Co., Bridgeport | 30.0 |
| | | | F. S. Bidwell & Co., Windsor Locks | 32.0 |
| | | | | 31.0 |
| 579 | Sanderson's Potato Manure | Sanderson Fertilizer & Chemical Co., New Haven | Dr. J. L. Buel,* Litchfield | 30.0 |
| | | | G. W. Eaton, Plainville | 30.0 |
| 591 | Mapes' Fruit & Vine Manure | Mapes F. & P. G. Co., N. Y. | Mapes' Branch, Hartford | 39.0 |
| | | | Birdsey & Raven, Meriden | 40.0 |
| 586 | Lister's Corn and Potato Fertilizer | Lister's Agricultural Chemical Works, | A. I. Martin, Wallingford | ..... |

## ANALYSES AND VALUATIONS—*Continued.*

| | Percentage difference between cost and valuation. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Total Nitrogen. | | | | | Total. | | So-called "Available." | | Found. | |
| | | As Nitrates. | As Ammonia. | Organic. | Found. | Guaranteed. | Water-soluble. | Citrate-soluble. | Citrate-insoluble. | Found. | Guaranteed. | Found. | Guaranteed. | As Muriate. | Total. |
| | 67.3 | 0.66 | --- | 1.42 | 2.08 | 2.1 | 7.25 | 1.56 | 2.06 | 10.87 | 9.0 | 8.81 | 8.0 | 2.23 | 2.23 |
| ! | 67.8 | --- | --- | 1.73 | 1.73 | 1.7 | 4.80 | 3.21 | 3.06 | 11.07 | 9.0 | 8.01 | 7.0 | 2.57 | 2.57 |
| : | 68.3 | 0.47 | --- | 2.01 | 2.48 | 2.5 | 7.52 | 2.26 | 1.23 | 11.01 | 11.0 | 9.78 | 9.0 | 2.52 | 2.52 |
| 5 | 68.9 | 0.42 | --- | 1.66 | 2.08 | 2.1 | 7.71 | 1.58 | 1.11 | 10.40 | 9.0 | 9.29 | 8.0 | 2.92 | 2.92 |
| 5 | 69.0 | 0.41 | --- | 1.74 | 2.15 | 2.0 | 4.45 | 5.08 | 2.88 | 12.41 | 11.0 | 9.53 | 8.0 | 3.31 | 3.31 |
| 2 | 69.0 | --- | --- | 2.21 | 2.21 | 2.1 | 7.28 | 2.10 | 1.29 | 10.67 | 9.0 | 9.38 | 8.0 | 1.84 | 1.8 |
| 5 | 69.1 | 0.47 | --- | 1.03 | 1.50 | 0.8 | 6.96 | 1.67 | 1.26 | 9.89 | 9.0 | 8.63 | 7.5 | 0.11 | 3.1 |
| 5 | 69 7 | 0.68 | --- | 1.27 | 1.95 | 2.0 | 3.50 | 4.99 | 3.86 | 12.35 | 10.0 | 8.49 | 8.0 | 5.54 | 5.5 |
| 4 | 69.8 | --- | --- | 1.85 | 1.85 | 1.6 | 6.03 | 2.36 | 1.29 | 9.68 | 8.0 | 8.39 | 7.0 | 4.20 | 4.2 |
| '9 | 70.6 | --- | --- | 1.80 | 1.80 | 1.7 | 2.58 | 3.86 | 0.98 | 7.42 | 8.0 | 6.44 | 5.0 | 6.03 | 6.0 |
| )1 | 71.9 | 0.78 | 0.46 | 0.82 | 2.06 | 1.7 | none | 4.88 | 2.08 | 6.96 | 7.0 | 4.88 | 5.0 | 3.25 | 11.2 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 4.06 | 4.10 | 0.93 | 10.08 | 9.0 | 9.15 | 8.0 | 3.15 | 3.1 |

## SPECIAL MANURES.

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. |
|---|---|---|---|---|
| | 1. *Sampled by Station Agent:* | | | |
| 96 | E. Frank Coe's New Englander Potato Fertilizer | Coe-Mortimer Co., N. Y. | W. E. Warner & Bro., Westville | $28.0 |
| 24 | Wheeler's Bermuda Onion Grower | American Agricultural Chemical Co., N. Y. | F. M. Loomis, Granby | 28.0 |
| 98* | Buffalo Vegetable and Potato | Buffalo Fertilizer Co., Buffalo, N. Y. | Bishop & Lynes, Norwalk | 33.0 |
| | | | Warner & Hardin, Glastonbury | ----- |
| 02 | Bradley's Corn Phosphate | American Agricultural Chemical Co., N. Y. | C. M. Beach, New Milford | 32.0 |
| | | | F. S. Bidwell & Co., Windsor Locks | 32.0 |
| 35 | Wheeler's Potato Manure | American Agricultural Chemical Co., N. Y. | J. R. Morgan, Bethel | 34.0 |
| 01 | Mapes' Cereal Brand | Mapes F. & P. G. Co., N. Y. | Mapes' Branch, Hartford | 28.0 |
| | | | A. N. Clark, Milford | 28.0 |
| 43 | Armour's Grain Grower | Armour Fertilizer Works, Baltimore, Md. | Edward White, Rockville | 27.0 |
| 94 | Bowker's Potato and Vegetable Phosphate | Bowker Fertilizer Co., N. Y. | W. T. McKenzie, Yalesville | 33.0 |
| | | | Lightbourn & Pond Co., New Haven | 33.0 |
| 28 | Columbian Potato Fertilizer | Coe-Mortimer Co., N. Y. | Balch & Pratt, Winsted | 31.0 |
| 59 | Read's Practical Potato Special | American Agricultural Chemical Co., N. Y. | H. A. Welton, Thomaston | 32.0 |
| | | | A. H. Cashen, Meriden | 30.0 |
| | | | | 31.0 |
| 03 | Bowker's Corn Phosphate | Bowker Fertilizer Co., N. Y. | W. T. McKenzie, Yalesville | 33.0 |
| | | | J. F. Silliman & Co., New Canaan | 33.0 |
| 39 | Wheeler's Corn Fertilizer | American Agricultural Chemical Co., N. Y. | J. R. Morgan, Bethel | 34.0 |
| 04 | N. E. Corn and Grain Fertilizer | New England Fertilizer Co., Boston, Mass. | A. T. Camp, Hawleyville | 30.0 |
| | | | M. D. Stanley, New Britain | 30.0 |
| 08 | Bowker's Lawn and Garden Dressing | Bowker Fertilizer Co., N. Y. | Bishop & Lynes, Norwalk | 55.0 |
| | | | Lightbourn & Pond [illegible] | |

## Analyses and Valuations—*Continued.*

| | Percentage difference between cost and valuation. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | As Nitrates. | As Ammonia. | Organic. | Total Nitrogen. | | Water-soluble. | Citrate-soluble. | Citrate-insoluble. | Total. | | So-called "Available." | | Found. | |
| | | | | | Found. | Guaranteed. | | | | Found. | Guaranteed. | Found. | Guaranteed. | As Muriate. | Total. |
| 6 | 75.0 | 0.40 | --- | 1.10 | 1.50 | **0.8** | 6.98 | 1.41 | 1.23 | 9.62 | **9.0** | 8.39 | **7.5** | 0.35 | 2.7 |
| 4 | 75.8 | --- | --- | 1.10 | 1.10 | **0.8** | 7.04 | 1.65 | 1.75 | 10.44 | **9.0** | 8.69 | **8.0** | 4.12 | 4.1 |
| 8 | 77.9 | 0.60 | 0.33 | 0.83 | 1.76 | **2.5** | 4.54 | 2.65 | 1.59 | 8.78 | **9.0** | 7.19 | **8.0** | 2.82 | 5.91 |
| 2 | 78.1 | --- | --- | 2.13 | 2.13 | **2.1** | 7.28 | 1.66 | 1.37 | 10.31 | **9.0** | 8.94 | **8.0** | 1.95 | 1.95 |
| 5 | 79.8 | --- | 0.20 | 2.08 | 2.28 | **2.1** | 6.61 | 1.72 | 1.02 | 9.35 | **9.0** | 8.33 | **8.0** | 3.26 | 3.2 |
| 1 | 82.8 | 0.62 | 0.54 | 0.71 | 1.87 | **1.7** | 1.41 | 4.64 | 2.34 | 8.39 | **8.0** | 6.05 | **6.0** | 3.33 | 3.3 |
| 3 | 83.8 | 0.65 | --- | 0.80 | 1.45 | **1.7** | 5.18 | 3.01 | 0.77 | 8.96 | **10.0** | 8.19 | **8.0** | 2.59 | 2.5 |
| 4 | 91.6 | 0.15 | --- | 1.65 | 1.80 | **1.7** | 6.43 | 3.01 | 1.08 | 10.52 | **10.0** | 9.44 | **9.0** | 2.33 | 2.3 |
| 8 | 93.3 | 0.41 | --- | 0.99 | 1.40 | **1.2** | 6.77 | 2.23 | 1.57 | 10.57 | **10.0** | 9.00 | **8.5** | 0.47 | 2.6 |
| 9 | 99.4 | 0.05 | --- | 0.96 | 1.01 | **0.8** | 2.80 | 1.95 | 2.73 | 7.48 | **5.0** | 4.75 | **4.0** | 7.83 | 7.8 |
| 3 | 102.3 | --- | --- | 1.62 | 1.62 | **1.7** | 5.49 | 3.26 | 1.75 | 10.50 | **9.0** | 8.75 | **8.0** | 2.43 | 2.4 |
| 9 | 107.1 | --- | --- | 1.39 | 1.39 | **1.7** | 7.02 | 1.89 | 1.73 | 10.64 | **9.0** | 8.91 | **8.0** | 3.25 | 3.2 |
| 4 | 117.2 | --- | --- | 1.30 | 1.30 | **1.2** | 5.34 | 2.39 | 1.33 | 9.06 | **8.0** | 7.73 | **7.0** | 2.06 | 2.0 |
| 8 | 157.1 | 0.89 | 1.40 | 0.91 | 3.20 | **3.0** | 3.25 | 1.75 | 0.74 | 5.74 | **8.0** | 5.00 | **4.0** | 5.39 | 5.3 |

## Special Manures.

| | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. |
|---|---|---|---|---|
| | 1. *Sampled by Station Agent:* | | | |
| 1 | Peruvian Guano for Legumes and Fruit | Coe-Mortimer Co., N. Y. | Atwater Bros.,* New Haven | ...... |
| 3 | Coe's Excelsior Potato Fertilizer | Coe-Mortimer Co., N. Y. | Atwater Bros.,* New Haven | ...... |
| | 2. *Sampled by purchasers and others:* | | *Sent by* | |
| 2 | Soluble Tobacco Manure | The Rogers Mfg. Co., Rockfall | John B. Cannon, Granby | $44.00 |
| 3 | Soluble Tobacco Manure | The Rogers Mfg. Co., Rockfall | Wm. W. Thompson, Warehouse Point | 45.00 |
| 8 | Special Mixture for Seed and Potatoes | The Everett B. Clark Co., Milford | M. A. Fitzgerald, Stratford | 30.00 |
| 9 | Soluble Tobacco Manure | The Rogers Mfg. Co., Rockfall | Poquonock Agr'l Co., Poquonock | 44.00 |
| 0 | Tobacco Grower | The Rogers Mfg. Co., Rockfall | Poquonock Agr'l Co., Poquonock | 38.00 |
| 5 | Essex Conn. Valley Tobacco Special | Russia Cement Co., Gloucester, Mass. | E. B. Kibbe, Hartford | 46.00 |
| 2 | Fertilizer for Potatoes | Wilcox Fertilizer Works, Mystic | Geo. K. Brush, Fitchville | 32.00 |
| 2† | Chittenden's Excelsior Potato Fertilizer | Nation'l Fertilizer Co., Bridgeport | Edward Deacon, Bridgeport | 35.00 |
| 5 | Swift's Lowell Potato Phosphate | Swift's Lowell Fertilizer Co., Boston, Mass. | Charles H. Brainard, Thompsonville | ...... 34.50 |

* Purchaser. † See notice under guaranties, p. 67.

### *Special Tobacco Manures, claimed to contain potash, either wholly or in part in form of Carbonate.*

In the table on pages 92 and 93 are given sixteen analyses of mixtures of this kind which require some special explanation, most of it repeated from former reports.

All of these mixtures are claimed to contain potash, largely in form of carbonate, and "available" phosphoric acid. The trade name "available phosphoric acid" has already been discussed on page 27 of this report. It should be added

ANALYSES AND VALUATIONS—*Concluded.*

| | Percentage difference between cost and valuation. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Total Nitrogen. | | | | | Total. | | So-called "Available" | | Found. | |
| | | As Nitrates. | As Ammonia. | Organic. | Found. | Guaranteed. | Water-soluble. | Citrate-soluble. | *Citrate-insoluble.* | Found. | Guaranteed. | Found. | Guaranteed. | As Muriate. | Total. |
| 1 | ---- | 0.04 | 1.66 | 1.07 | 2.77* | **2.0** | 1.68 | 9.29 | 2.85 | 13.82 | **12.0*** | 10.97 | --- | 2.79 | 14.29 |
| 3. | ---- | --- | 1.27 | 1.39 | 2.66 | **2.5** | 6.55 | 1.93 | 1.60 | 10.08 | **9.0** | 8.48 | **7.0** | 0.93 | 7.79 |
| 2 | 19.8 | 1.87 | --- | 3.03 | 4.90 | **5.0** | 0.90 | 8.66 | 2.00 | 11.56 | **8.0** | 9.56 | **6.0** | 0.97 | 10.96 |
| 3 | 20.8 | 2.04 | --- | 3.11 | 5.15 | **5.0** | 1.60 | 7.03 | 1.48 | 10.11 | **8.0** | 8.63 | **6.0** | 1.18 | 11.53 |
| 3 | 21.2 | 0.72 | 0.63 | 1.98 | 3.33 | **3.3** | 6.00 | 1.54 | 0.80 | 8.34 | **8.0** | 7.54 | ---- | 6.93 | 6.93 |
| ) | 22.3 | 1.96 | 0.10 | 3.07 | 5.13 | **5.0** | 1.82 | 6.82 | 1.77 | 10.41 | **8.0** | 8.64 | **6.0** | 1.32 | 10.18 |
| ) | 27.0 | 1.65 | --- | 3.73 | 5.38 | ---- | 1.44 | 3.97 | 0.40 | 5.81 | ---- | 5.41 | ---- | 1.09 | 6.18 |
| ; | 33.0 | 1.70 | 0.04 | 2.96 | 4.70 | **5.0** | 5.15 | 3.74 | 1.49 | 10.38 | **7.0** | 8.89 | ---- | 1.00 | 9.80 |
| : | 41.7 | 0.05 | 0.22 | 2.07 | 2.34 | ---- | 4.22 | 1.71 | 0.33 | 6.26 | ---- | 5.93 | ---- | 10.21 | 10.21 |
| : | 44.3 | 0.68 | 0.21 | 2.01 | 2.90 | **3.3** | 3.20 | 1.37 | 0.70 | 5.27 | **8.0** | 4.57 | **6.0** | 11.26 | 11.26 |
| ; | 51.1 | --- | --- | 2.48 | 2.48 | **2.5** | 5.28 | 3.96 | 1.76 | 11.00 | **9.0** | 9.24 | **8.0** | 5.93 | 5.93 |

manures, from which the alkali cannot be removed by washing with water and which contain no considerable amount of water-soluble phosphates, the conditions prescribed for the use of the ammonium citrate cannot be maintained, and the term "available" phosphoric acid has no definite significance and is of no use in fixing the value of the fertilizer. It is a perfectly meaningless term as applied to such goods as these.

Regarding the guaranty of carbonate of potash, in many cases a chemical analysis cannot certainly prove or disprove the statement that potash is present in that form. The presence

of sulphuric acid and chlorine, even in considerable amount, does not necessarily disprove the statement of the manufacturers that the potash in the mixture was introduced wholly as carbonate, for both sulphuric acid and chlorine may have come from other articles used in the mixture, such as acid phosphate, acid fish, plaster, or whatever else may have been employed along with carbonate of potash.

But the object of using carbonate of potash in tobacco fertilizers is to exclude both chlorides and sulphates. The reason for excluding them is the fear that the quality of the crop will be damaged by their presence.

Our experiments, as well as the experience of growers of tobacco in Connecticut, have also proved that some form of carbonate is one of the best sources from which to supply potash to the tobacco crop.

It is an expensive form of potash, but its use is rational, *if thereby sulphates and chlorides are excluded.* But it is quite irrational, because wasteful, to use the relatively expensive carbonate of potash in a mixed fertilizer and to introduce, at the same time, either sulphates or chlorides in other forms than in potash salts, for instance as acid fish, dissolved phosphate, or plaster, for there is no doubt that sulphates or chlorides may be equally harmful to the quality of the tobacco leaf, whether introduced into the fertilizer as potash salts or in other forms.

In making valuations for these fertilizers, potash sufficient to combine with the chlorine present is calculated as chloride; potash sufficient to combine with all the sulphuric acid present is calculated as sulphate, and any excess of potash remaining is then calculated as carbonate. But we repeat that this is merely a calculation for making a valuation and that it does not necessarily conflict with the manufacturers' statements that a part or all of the potash was put into the mixture as high-grade carbonate.

### *Analyses Requiring Special Notice.*

Analysis, **16597**, given below, was made on a mixture of two samples of Bowker's Complete Alkaline Tobacco Grower; one from stock of Bowker's Branch, Hartford, the other from H. F. Edwards, Suffield. The manufacturer objected that the sulphuric acid found, 4.18 per cent., was much higher than the goods now on the market should contain.

Separate test for sulphuric acid was therefore made in the two samples and one was found to contain 6.48 per cent. while the other, from Mr. Edwards, had but 1.70 per cent. Another sample drawn by our agent at the Bowker Branch contained 2.07. Other samples, given in the table, **16703**, from Seth Viets (stock of S. L. Wood), and **16820** from E. G. Farren, Tariffville, contained 1.56 and 0.97 per cent, respectively, of sulphuric acid. The single sample drawn from Bowker's Branch early in the season, therefore, has much more sulphuric acid than the other four samples. The two analyses given in the table also differ strikingly in their content of phosphoric acid. The analysis of **16597** is as follows:

| | |
|---|---|
| Organic nitrogen .................. | 4.34 |
| Water-soluble phosphoric acid ...... | 0.32 |
| Citrate-soluble " " ...... | 2.97 |
| Citrate-insoluble " " ...... | 3.21 |
| Total phosphoric acid.............. | 6.50 |
| Potash calculated as muriate ....... | 0.85 |
| " " " sulphate ....... | 3.78 |
| " " " carbonate ...... | none |
| Total water-soluble potash.......... | 4.63 |
| Chlorine .......................... | 0.64 |
| Sulphuric acid ..................... | 4.18 |
| Valuation per ton.................. | $24.51 |

**16596** is a sample of Swift's Perfect Tobacco Grower drawn May 2 and April 11, from stock of Loomis Bros., Granby, and F. S. Bidwell & Co., Windsor Locks. Regarding it the manufacturer writes:

"We would say it does not fairly represent most of that brand shipped into Connecticut this year. After carefully reading your comments on tobacco fertilizers found in 1905 report, we concluded to change our formula to eliminate the objectionable features. Unfortunately we had made some early shipments in February, and the first of March, to a few agents, but after March 12th, all our Perfect Tobacco Grower consisted of the new formula which eliminates the use of sulphuric acid, and contains potash in the form of carbonate only. While by your method of determining potash, we do not get full credit for carbonate, it is the fact that only carbonate has been used in this formula since March 12th."

Request was made that another sample be drawn which was done and its analysis appears in the table, No. **16830**. The analysis of **16596** is as follows:

## TOBACCO FERTILIZERS CONTAINING CARBONATES.

| Station No. | Name or Brand. | Manufacturer. | Dealer or Pur |
|---|---|---|---|
| 3700 | Home Mixture for Tobacco | P. P. Hickey, Burnside | Manufacturer |
| 3595 | Complete Tobacco Manure | Am. Agric. Chem. Co., N. Y. City | S. T. Welden, Sims<br>C. M. Beach, New<br>E. N. Austin, Suffi |
| 3708§ | *Bowker's Complete Alkaline Tobacco Grower* | Bowker Fertilizer Co., N. Y. | Seth Viets,* West S |
| 3820§ | Bowker's Complete Alkaline Tobacco Grower | " " " " | E. G. Farren, Tarif |
| 3702 | Bowker's Tobacco Ash Elements | " " " " | Seth Viets, West Su<br>*Newell St. John, Si* |
| 3704 | Mapes' Tobacco Manure, Wrapper Brand | Mapes F. & P. G. Co., N. Y. | Mapes' Branch, Ha<br>Joseph Thrall, Win<br>O. S. Wood, Elling |
| 3599 | Mapes' Tobacco Ash Constituents | " " " " | Spencer Bros., Suffi<br>F. S. Bidwell & ( Locks |
| 3480 | Chittenden's Tobacco Special with Carbonate of Potash | National Fertilizer Co., Bridgeport | L. O. Pomeroy,† Su |
| 3882 | N. E. Perfect Tobacco Grower | N. E. Fertilizer Co., Boston | R. A. Hardin, Glast |
| 3807 | " " " " | " " " " | " " |
| 3240 | O. & W's. Complete Tobacco Fertilizer | Olds & Whipple, Hartford | P. S. Brewer, Silve |
| 3268 | O. & W's. Complete Tobacco Fertilizer | " " " " | Clark Bros., Poquo |
| 3479 | O. & W's. Complete Tobacco Fertilizer | " " " " | J. C. Eddy,‡ Simsb |
| 3050 | O. & W's. Complete Tobacco Fertilizer | " " " " | L. R. Lord, Poquor |
| 3861 | O. & W's. Complete Tobacco Fertilizer | " " " " | Willard E. Treat, S |
| 3880§ | Swift's Lowell Perfect Tobacco Grower | Swift's Lowell Fertilizer Co., Boston | T. J. Coleman, Wa<br>E. J. Bulkley, Wet |

* Stock of S. L. Wood. † Stock of Jos. Frolinger. ‡ Stock of Jos. Frolinger, Suffi

§ See notice on p. 91.

*Percentage amounts of*

| | |
|---|---|
| Nitrogen as nitrates | 0.18 |
| " " ammonia | 0.95 |
| " organic | 2.89 |
| " total | 4.02 |
| Water-soluble phosphoric acid | 4.32 |
| Citrate-soluble " " | 5.53 |
| Citrate-insoluble " " | 1.54 |
| Total " " | 11.39 |
| Potash calculated as muriate | 2.74 |
| " " " sulphate | 3.61 |
| Total potash | 6.35 |
| Chlorine | 2.06 |
| Sulphuric acid | 16.78 |
| Valuation per ton | $29.48 |

## ANALYSES AND VALUATIONS.

| …OGEN. | | | PHOSPHORIC ACID. | | | | | | | POTASH. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total. | | | | | Total. | | So-called "Available." | | | | | | | | | |
| Organic. | Found. | Guaranteed. | Water-soluble. | Citrate-soluble. | Citrate-insoluble. | Found. | Guaranteed. | Found. | Guaranteed. | Guaranteed. | Water-soluble. | Calculated as chloride. | Calculated as sulphate. | Calculated as carbonate. | Chlorine. | Sulphuric acid. | Cost per ton. |
| .76 | 5.76 | .... | trace | 2.99 | 0.96 | 3.95 | .... | 2.99 | .... | .... | 14.02 | 0.57 | 0.21 | 13.24 | 0.43 | 0.18 | $40.00 |
| .46 | 4.46 | **4.5** | none | 5.36 | 1.74 | 7.10 | **4.0** | 5.36 | **3.0** | **5.5** | 4.93 | 1.37 | 1.67 | 1.89 | 1.03 | 1.42 | 35.00 |
| | | | | | | | | | | | | | | | | | 37.00 |
| | | | | | | | | | | | | | | | | | 34.00 |
| .52 | 4.52 | **4.1** | 0.56 | 3.32 | 3.92 | 7.80 | **5.0** | 3.88 | **4.0** | **5.0** | 4.18 | 0.72 | 1.83 | 1.63 | 0.54 | 1.56 | 35.00 |
| .43 | 4.43 | **4.1** | 0.16 | 9.48 | 4.91 | 14.55 | **5.0** | 9.64 | **4.0** | **5.0** | 5.17 | 0.45 | 1.14 | 3.58 | 0.34 | 0.97 | 36.00 |
| .84 | 0.84 | .... | trace | 7.95 | 4.66 | 12.61 | **7.0** | 7.95 | **6.0** | **15.0** | 14.46 | 1.21 | 13.25 | ..... | 0.91 | 14.40 | 31.00 |
| | | | | | | | | | | | | | | | | | 33.00 |
| .88 | 6.41 | **6.2** | trace | 4.95 | 0.74 | 5.69 | **4.5** | 4.95 | .... | **10.5** | 10.98 | 1.94 | 4.17 | 4.87 | 1.46 | 3.55 | 46.00 |
| | | | | | | | | | | | | | | | | | 45.00 |
| | | | | | | | | | | | | | | | | | 46.00 |
| .70 | 0.70 | **0.5** | none | 4.15 | 2.25 | 6.40 | **5.7** | 4.15 | .... | **15.0** | 15.37 | 2.41 | 5.61 | 7.35 | 1.81 | 4.77 | 33.00 |
| | | | | | | | | | | | | | | | | | 33.00 |
| .58 | 4.58 | **4.0** | 0.06 | 5.18 | 3.08 | 8.32 | **4.0** | 5.24 | **3.0** | **5.5** | 5.21 | 1.24 | 1.75 | 2.22 | 0.93 | 1.40 | 34.00 |
| .98 | 4.07 | **4.1** | 4.32 | 6.06 | 1.24 | 11.62 | **8.0** | 10.38 | **7.0** | **6.0** | 6.19 | 1.08 | 5.11 | ..... | 0.81 | 16.24 | 39.00 |
| .41 | 4.33 | **4.1** | 3.26 | 6.24 | 2.17 | 11.67 | **8.0** | 9.50 | **7.0** | **6.0** | 6.18 | 0.65 | 2.74 | 2.79 | 0.49 | 2.33 | ...... |
| .59 | 5.29 | **4.5** | .... | 4.28 | 0.30 | 4.58 | **3.0** | 4.28 | **3.0** | **5.5** | 6.15 | 0.47 | 1.17 | 4.51 | 0.35 | 0.99 | 34.00 |
| .51 | 5.24 | **4.5** | none | 4.86 | 0.27 | 5.13 | **3.0** | 4.86 | **3.0** | **5.5** | 6.28 | 0.60 | 0.96 | 4.72 | 0.45 | 0.82 | 36.00 |
| .93 | 4.75 | **4.5** | 0.22 | 5.90 | 0.28 | 6.40 | **3.0** | 6.12 | **3.0** | **5.5** | 5.80 | 1.17 | 1.91 | 2.72 | 0.88 | 1.62 | 35.00 |
| .15 | 4.90 | **4.5** | 0.14 | 4.45 | 0.32 | 4.91 | **3.0** | 4.59 | **3.0** | **5.5** | 5.55 | 1.52 | 1.08 | 2.95 | 1.14 | 0.92 | 35.00 |
| .92 | 4.61 | **4.5** | none | 3.59 | 0.25 | 3.84 | **3.0** | 3.59 | **3.0** | **5.5** | 5.55 | 1.49 | 0.98 | 3.08 | 1.12 | 0.83 | 35.00 |
| .52 | 3.58 | **4.1** | 2.16 | 6.52 | 2.36 | 11.04 | **8.0** | 8.68 | **7.0** | **6.0** | 5.19 | 1.12 | 2.15 | 1.92 | 0.84 | 1.83 | 40.00 |
| | | | | | | | | | | | | | | | | | 40.00 |

* Valuation exceeds cost.

**16779** and **16780** are two samples of the American Agricultural Chemical Co.'s Tobacco Fertilizer sent by Broad Brook Lumber & Coal Co.

After making the determinations we were advised by the sender that the samples were not fair ones, being taken from a few bags and not properly mixed!

It is an invariable rule of this station to publish every fertilizer analysis which is made, with what explanation is necessary.

ANALYSES.

| | 16779 | 16780 |
|---|---|---|
| *Percentage amounts of* | | |
| Nitrogen .......................... | 4.24 | 4.48 |
| Water-soluble potash .............. | 5.04 | 6.05 |

**16863** is a fertilizer, brand unknown, stated to be made specially for tobacco, to contain a considerable amount of humus and no acids. Sent by Indian Head Plantation, Tariffville.

ANALYSIS.

| | 16863 |
|---|---|
| Nitrogen, organic | 1.90 |
| Water-soluble phosphoric acid | 2.88 |
| Citrate-soluble " " | 1.19 |
| Citrate-insoluble " " | 0.60 |
| Total " " | 4.67 |
| Potash, calculated as muriate | 2.31 |
| Valuation per ton | $12.77 |
| *It contains moisture* | 24.61 |
| *organic and volatile matter* | 29.06 |
| *mineral matter* | 46.33 |
| | 100.00 |

*It is a nitrogenous superphosphate of very ordinary composition.*

## HOME MIXTURES.

In the following table are analyses of eleven home-mixtures of chemicals used in place of factory mixtures. They were in most cases sampled and sent by the persons who made them.

HOME MIXTURES. FORMULAS,

| Station No. | Made by | Formulas. Pounds per ton | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Nitrate of Soda. | Castor Pomace. | Dry Fish. | Tankage. | Ground Bone. | Dissolved Bone Black. | Acid Phosphate. | Muriate of Potash. |
| 16112 | Andrew Ure, Highwood | --- | --- | --- | --- | --- | --- | --- | -- |
| 16396 | J. G. Schwink, Meriden | 125 | --- | --- | 675 | --- | --- | 800 | 12 |
| 16401 | Conn. School for Boys, Meriden | 500 | --- | --- | 500 | --- | --- | 400 | 25 |
| 16402 | Conn. School for Boys, Meriden | 100 | --- | --- | 750 | --- | --- | 750 | 20 |
| 16434 | A. C. Lake, Watertown | 90 | --- | --- | --- | 392 | --- | 908 | 61 |
| 16540 | Andrew Kingsbury, Rockville | 400 | --- | --- | --- | 500 | --- | 500 | -- |
| 16647 | Dennis Fenn, Milford | 200 | --- | --- | 800 | 200 | 600 | --- | 20 |
| 16648 | Dennis Fenn, Milford | 300 | --- | --- | 800 | --- | 600 | --- | 30 |
| 16674 | H. H. McKnight, Ellington | 236 | --- | --- | --- | 688 | --- | 688 | 38 |
| 16701 | Robert B. Fowler, Guilford | 100 | --- | 300 | 600 | --- | --- | 700 | 30 |
| 16725 | C. W. Covell, East Windsor Hill | --- | 824 | 706 | --- | --- | --- | --- | -- |

Samples **16647** and **16648** were mixed for the buyer by a fertilizer company according to a fórmula furnished by him.

The cost price given does not, in most cases, cover the cost of mixing, but only that of the chemicals delivered.

Regarding cost of mixing Mr. Lake writes: "I have screened the potash and nitrate of soda, mixed two and a half tons to-day and bagged it, in nine hours,—less than fifty cents per ton."

The average cost of the chemicals in these home-mixtures, unmixed, was $27.88. If we figure the cost of mixing at $2.12 per ton the average cost would be $30.00. In any event the average cost is not above the valuation.

By referring to page 68 comparison may be made between the amounts of nitrogen, phosphoric acid and potash which the buyer gets for $30.00 cash in the average and in the highest grade nitrogenous superphosphate and the amounts which he may get in home-mixtures like the above.

Purchased for Thirty Dollars.

| | In the average factory-mixed superphosphates. | In the highest grade superphosphates. | In the home-mixtures. |
|---|---|---|---|
| Nitrogen ...... | 49 pounds | 73 pounds | 77 pounds |
| Phosphoric acid | 193 " | 188 " | 200 " |
| Potash ....... | 90 " | 111 " | 168 " |

Analyses and Valuations.

| of Mixtures. | | | Analyses. | | | | | | | | Cost (Unmixed) and Valuation. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Double Sulphate of Potash. | Saltpeter Waste. | Kainit. | Nitrogen as Nitrates. | Nitrogen, Organic. | Total Nitrogen. | Water-soluble Phosphoric Acid. | Citrate-soluble Phosphoric Acid. | Citrate-insoluble Phosphoric Acid. | Total Phosphoric Acid. | Potash. | Cost per ton. | Valuation per ton. |
| --- | ---- | ---- | 2.85 | 1.72 | 4.57 | 3.44 | 4.41 | 2.06 | 9.91 | 5.77 | ------ | $28.12 |
| 275 | ---- | ---- | 0.94 | 1.74 | 2.68 | 4.99 | 5.03 | 1.72 | 11.74 | 7.47 | $22.00 | 25.43 |
| --- | ---- | 350 | 3.73 | 1.19 | 4.92 | 2.88 | 3.51 | 0.90 | 7.29 | 9.05 | 27.65 | 30.16 |
| 200 | ---- | ---- | 0.69 | 2.01 | 2.70 | 4.88 | 5.36 | 2.17 | 12.41 | 7.64 | 22.88 | 25.86 |
| --- | ---- | ---- | 1.12 | 1.60 | 2.72 | 3.36 | 7.21 | 2.15 | 12.72 | 12.78 | 26.45 | 30.13 |
| --- | 600 | ---- | 3.84 | 0.12 | 3.96 | 3.06 | 6.79 | 0.40 | 10.25 | 8.82 | 26.24 | 28.95 |
| --- | ---- | ---- | 2.04 | 2.62 | 4.66 | 1.09 | 5.14 | 2.71 | 8.94 | 7.59 | 32.00 | 29.04 |
| --- | ---- | ---- | 2.27 | 2.62 | 4.89 | 0.91 | 4.78 | 2.32 | 8.01 | 8.34 | 34.00 | 29.84 |
| --- | ---- | ---- | 1.73 | 1.12 | 2.85 | 3.63 | 8.22 | 2.82 | 14.67 | 10.59 | 31.20 | 29.83 |
| --- | ---- | ---- | 0.89 | 2.99 | 3.88 | 4.34 | 5.21 | 1.30 | 10.85 | 8.30 | 27.08 | 29.66 |
| 470 | ---- | ---- | ---- | 4.86 | 4.86 | 0.32 | 2.70 | 0.28 | 3.30 | 5.99 | 29.33 | 26.43 |

If a farmer or a number of farmers buy and use a considerable number of tons of fertilizer and are willing to pay cash there is no question as to the economy of home-mixing as a rule.

Quotations should be obtained in all cases with a statement of guaranteed composition, from a number of firms in the early winter, so that the chemicals may be delivered and tested in ample time for screening and mixing before the spring opens. In all cases there should be a perfectly clear understanding as to rebates in case the goods fall below their guaranties.

## VEGETABLE POTASH.

**16369.** "Vegetable Potash", sold by Olds & Whipple, Hartford, contains 27.22 per cent. of potash soluble in water. It costs $40.00 per ton, equivalent to 7.3 cents per pound, for the potash, which is chiefly in form of carbonate.

## COTTON HULL ASHES.

This material is the ashes of the hulls which are separated from the "meats" of the cotton seed preliminary to the expression of cotton seed oil. For a time these ashes were abundant in our market and were the most generally satisfactory potash fertilizer for tobacco ever offered in our market.

Below are given analyses of twenty-one samples of the ashes, representing goods bought during 1906.

**16767,** H. M. 2. Sold to Spencer Bros.; **16768,** H. M. 3, sold to A. P. Sherwin, Suffield; **16662,** H. T. sold to O. E. Pitcher, H. Fuller and others; **16766,** H. M. 1, sold to L. M. Pomeroy, West Suffield; **16027,** sold to the Bissell, Graves Co. and sampled by them; **15889, 15890, 15891,** sampled by station agent; **16093** from F. F. Ford; **16534,** sampled and sent by E. S. Seymour, Windsor Locks; **16095** from D. L. Brockett, Suffield.

All of the above are from stock sold by Arthur Sikes, Suffield.

**16154.** Sold by Spencer Bros., Suffield. Sampled and sent by E. Halladay.

**16463.** Sold by The Loomis Bros Co., Granby. Sampled and sent by A. H. Griffin, Granby.

**16537.** Sold by The Loomis Bros. Co., Granby. Sampled and sent by H. G. Viets, Granby.

**16347.** Sold by W. F. Fletcher, Southwick, Mass. Sampled and sent by J. B. Cannon, Granby.

**16466.** Sold by Spencer Bros., Suffield. Sampled and sent by G. A. Harmon, Suffield.

**16168.** Car No. 33067. Sold by Spencer Bros., Suffield. Sampled and sent by Bissell, Graves Co., Suffield.

**16181.** Sold by Spencer Bros., Suffield. Sampled and sent by G. A. Peckham, Suffield.

**16492.** Sampled and sent by The Loomis Bros. Co., Granby.

**16094.** Sold by Arthur Sikes, Suffield. Sent by J. F. Brockett, Suffield.

**16573.** "Cotton Boll Ashes." Sold by Spencer Bros., Suffield. Sampled and sent by Clinton Spencer, Suffield.

ANALYSES OF COTTON HULL ASHES.

| Station No. | Water-soluble potash. | Total potash. | Total phosphoric acid. | Cost per ton. | Potash costs, cents per pound. |
|---|---|---|---|---|---|
| 16767 | 10.12 | .... | ... | $22.00 | 7.7 |
| 16768 | 12.92 | .... | ... | 28.00 | 8.4 |
| 16662 | 21.34 | .... | 7.89 | 43.00 | 8.6 |
| 16766 | 15.04 | .... | ... | 32.50 | 8.7 |
| 16027 | 19.90 | 22.24 | 7.46 | 43.00 | 9.2 |
| 15889 | 18.90 | .... | ... | 42.00 | 9.4 |
| 15890 | 18.18 | .... | ... | 40.50 | 9.4 |
| 15891 | 18.90 | .... | ... | 42.00 | 9.4 |
| 16093 | 19.20 | .... | ... | 43.00 | 9.5 |
| 16534 | 18.34 | .... | ... | 43.00 | 10.0 |
| 16095 | 18.20 | .... | ... | 43.00 | 10.1 |
| 16154 | 19.20 | 21.56 | ... | 45.00 | 10.1 |
| 16463 | 18.58 | .... | 7.68 | 44.00 | 10.1 |
| 16537 | 18.53 | .... | ... | 44.00 | 10.2 |
| 16347 | 17.72 | .... | ... | 44.00 | 10.6 |
| 16466 | 17.44 | .... | ... | 45.00 | 11.1 |
| 16168 | 16.38 | .... | ... | 45.00 | 11.8 |
| 16181 | 16.24 | .... | ... | 45.00 | 11.9 |
| 16492 | 15.66 | .... | ... | 44.00 | 12.0 |
| 16094 | 19.30 | .... | ... | 43.00 | 12.9 |
| 16573* | 20.98 | .... | ... | 47.21 | 11.3 |

Samples **16766, 16767** and **16768**, are of very low grade, containing 15.0 per cent or less of water-soluble potash and large percentages,—in case of **16766** 31.53 per cent.—of matters

* "Cotton Boll Ashes."

insoluble in acid—sand, soil and charcoal. They were sold, or settled for, at low prices so that the potash in them cost less than in most of the other samples.

In most of the samples only water-soluble potash was determined as it is chiefly this form of potash which fixes the value of the ashes. The percentage of phosphoric acid in its several forms is not nearly so variable as is the content of potash, being tolerably constant, and to determine it in any case very considerably delays the report of analysis to the persons concerned.

Most dealers as well as buyers do not care for it and for that reason the determination of phosphoric acid is not made unless specially requested.

The highest, lowest and average percentages of phosphoric acid found in 19 samples of cotton hull ashes analyzed last year were as follows:

| | Highest. | Lowest. | Average. |
|---|---|---|---|
| Water-soluble phosphoric acid.... | 1.33 | 0.19 | 0.77 |
| Citrate-soluble " " .... | 8.12 | 5.20 | 6.63 |
| Citrate-insoluble " " .... | 1.38 | 0.49 | 0.78 |
| Total phosphoric acid............ | 9.17 | 6.50 | 8.18 |
| Water-soluble potash ............ | 23.61 | 12.64 | 19.80 |

These figures show the tolerably uniform percentage of phos phoric acid, even where the percentage of water-soluble potasl ranges from 12 to 23 per cent.

Valuing the three forms of phosphoric acid at 4½, 4 and : cents, respectively, the valuation of the phosphate in a ton o cotton hull ashes will be, on the average, $6.30. Deducting thi from the cost price and dividing the remainder by the numbe of pounds of water-soluble potash in a ton gives the cost pe pound of water-soluble potash, as shown in the last column c the table.

**In the twenty-one samples of cotton hull ashes analyzed this yea the cost of water-soluble potash has ranged from 7.7 cents to 12.9 cen per pound, the average being 10.1 cents. This is 1¼ cents more th the average of last year.**

This is three cents per pound more than potash in form high grade carbonate has cost, yet, as has been said before, t form of potash has given such general satisfaction to tobac growers for a term of years.

## WOOD ASHES.

In the following table, page 100, are given analyses of fourteen samples of wood ashes which show the usual wide range of composition. The prices given are understood to be for car lots.

Sample **16574** was guaranteed to contain 6-8 per cent. of potash and 1.50-3.00 per cent. of phosphoric acid.

Sample **16602** was sent wrapped only in paper and was damp on receipt at the station. It is therefore probable that the analysis does not fairly represent the quality of the article.

It is the custom of dealers to guarantee only total potash. This includes not only the potash which is immediately or readily available to crops but also that combined in silicates, a part of which, at least, may not be thus available. What the buyer wants to know is, what potash is readily soluble, and this form of potash therefore the station determines.

The percentage of this water-soluble potash ranges from 4.78 to 3.82, excluding **16262** and **18297**, which are very inferior, and that of the lime from 35.98 to 24.89.

The average composition of the twelve samples is:

| | |
|---|---|
| Water-soluble potash | 4.27 |
| Phosphoric acid | 1.38 |
| Lime | 29.81 |
| Cost per ton | $10.07 |

If we value potash in these ashes at 7½ cents per pound and phosphoric acid at 4 cents, the lime in these wood ashes costs on the *average* about 43 cents per 100 pounds. No form of lime is probably better suited to the needs of the soil than the extremely fine carbonate which ashes contain.

## LIME AND LIME-KILN ASHES.

### *Lime.*

**16023.** Patent Process Fertilizer Lime; **16024** L. & A. Special Fertilizer Lime made by Walton Quarries, Harrisburg, Pa. Cost $10.00 per ton, f.o.b. at factory. Sent by F. R. Sammis, Stratford. As stated by the manufacturer "we take the limestone from the quarry and without any chemicals, but with the use of machinery, fire and water, we convert the lime

## WOOD ASHES. PERCENTAGE COMPOSITION.

| Station No. | Dealer or Purchaser. | Sampled or sent by | Total potash. | Water-soluble potash. | Phosphoric acid. | Lime. | Sand and charcoal. | Cost per ton. |
|---|---|---|---|---|---|---|---|---|
| | *Bowker Fertilizer Co., N. Y.* | | | | | | | |
| 16304 | Geo. E. Hough, Wallingford | Purchaser | 5.09 | 4.42 | 1.51 | 30.69 | 9.35 | $ 9.00 |
| 16678 | Patrick Heavey, Suffield | " | .... | 4.74 | 1.30 | 29.22 | 9.89 | 9.75 |
| 16679 | J. B. Parker, Poquonock | Station Agent | .... | 4.70 | 1.23 | 24.89 | 19.23 | 11.00 |
| | *John Joynt, Lucknow, Canada.* | | | | | | | |
| 16462 | E. H. Latimer & Son, Avon | Purchaser | .... | 4.12 | 1.15 | 27.90 | 17.73 | .... |
| 16535 | Chas. H. Phelps, Melrose | " | .... | 3.99 | 1.29 | 29.58 | 8.31 | 10.50 |
| 16574* | E. H. Latimer & Son, Avon | Station Agent | 4.49 | 3.82 | 1.06 | 25.10 | 20.27 | 11.00 |
| 16605 | F. S. Bidwell, Windsor Locks | " " | .... | 4.03 | 1.22 | 31.21 | 8.27 | 11.00 |
| | *F. R. Lalor, Dunnville, Canada* | | | | | | | |
| 15922 | A. N. Clark, Westville | Purchaser | 5.77 | 4.56 | 1.42 | 35.98 | 15.72 | 9.25 |
| 16602* | Thomas Holt, Southington | " | .... | 4.02 | 1.66 | 31.30 | 14.37 | 9.50 |
| 16025 | J. H. Elwood, Green's Farms | " | 4.77 | 4.07 | 1.28 | 30.01 | 6.08 | 502.95 |
| 18298 | D. N. Clark, Westville | " | .... | 4.02 | 1.73 | .... | .... | 9. |
| 16643 | G. A. Douglass, bought of H. K. Brainard, Thompsonville | " | .... | 4.78 | 1.30 | 32.02 | 7.34 | 10.50 |
| 16262 | Edgewood Brand, Elm City Nursery Co., New Haven | Elm City Nursery Co. | .... | 2.63 | 1.29 | 26.29 | 14.42 | .... |
| 18297 | S. T. Welden, Simsbury | Purchaser | .... | 2.23 | 1.15 | .... | .... | .... |

* See page 99.

into available plant-food." The material appears to be a fine, dry, slaked lime containing some carbonate. The freight on this material would make its use as a fertilizer or amendment in this state uneconomical.

**16250.** Unslaked Stone Lime, lime sold by Deeley & Sons, Lee, Mass. Sampled and sent by Dr. T. K. Marcy, Poquonock.

**16864.** R. R. Agricultural Lime, made by Rockland-Rockport Lime Co., Rockland, Me., sold by Olds & Whipple, Hartford. Price $10.00 per ton. Sampled and sent by R. A. McJunkin, Hartford.

**16201.** Steam slaked lime bought of Adamant Plaster Co., New Haven. Price $8.00 per ton. Sampled and sent by Frank P. Webster, New Haven. This is made from our magnesian limestone and contains a large amount of magnesia.

*Lime-kiln Ashes.*

**16461.** Sample of twenty tons bought of Deeley & Sons, Lee, Mass., by Mr. Merrell, Suffield, for $6.20 per ton, delivered. The sample was very wet, one-third of it by weight being water, which accounts for the low analysis.

**16251.** Sold by Deeley & Sons, Lee, Mass. Sampled and sent by Dr. T. K. Marcy, Poquonock. These ashes had been exposed to the weather for nearly a year. They were sold for 9 cents a bushel.

ANALYSES OF LIME AND LIME-KILN ASHES.

| Station No. | 16023 | 16024 | 16250 | 16864 | 16201 | 16461 | 1625 |
|---|---|---|---|---|---|---|---|
| *Percentage amounts of* | | | | | | | |
| Lime | 56.62 | 54.79 | 54.63 | 57.77 | 38.87 | 21.13 | 22.5 |
| Magnesia | 4.96 | 4.73 | 37.63 | 0.72 | 25.84 | 8.33 | --- |
| Sulphuric acid | 0.69 | 0.68 | ---- | ---- | 1.15 | ---- | --- |
| Water-soluble potash | ---- | ---- | ---- | ---- | ---- | 1.01 | 0.8 |
| Phosphoric acid | ---- | ---- | ---- | ---- | ---- | 0.85 | 0.9 |
| Price per ton | $10.00* | 10.00* | 5.00 | 10.00 | 8.00 | 6.20 | --- |
| Lime costs, cents per 100 pounds | .88 | .91 | .46 | .87 | 1.03 | .92 | --- |

It will be seen that the price of actual lime per 100 pounds ranges in these samples from 46 cents to $1.03. It is more expensive than in wood ashes.

*f. o. b. Harrisburg, Penn.

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## BRICK-KILN ASHES.

**16082.** Made by Berlin Brick Co. Sampled and sent by *Roy B. Smith, Berlin.*

ANALYSIS.

| *Percentage amounts of* | |
|---|---|
| Water-soluble potash | 2.10 |
| Lime | 41.98 |
| Magnesia | 3.65 |
| Phosphoric acid | 1.89 |
| Sand and clay | 19.91 |
| Charcoal | 0.67 |

Owing to the character of the wood burned, as well as the admixture of sand and clay, these ashes contain but a small percentage of potash. They contain over 40 per cent. of lime and, unlike the lime-kiln ashes made in the Housatonic Valley, contain but little magnesia. They are worth the attention of farmers living near the kilns who are using lime on their fields.

## ASHES OF TOBACCO STALKS.

**16642.** A sample of this material, sent by Chas. A. Prout of Suffield, contained:

| *Percentage amounts of* | |
|---|---|
| Phosphoric acid | 5.45 |
| Water-soluble potash | 35.37 |
| Chlorine | 2.33 |
| Sulphuric acid | 4.02 |

Calculated as in mixed tobacco fertilizers the potash would figure as follows: In form of muriate 3.10 per cent., as sulphate 4.73 per cent., as carbonate 27.54 per cent.

## ASHES FROM A BURNED TOBACCO WAREHOUSE.

**17883** is ashes from the buildings; **18296** is ashes and partly burned tobacco leaf, sent by Wm. L. Huntting, East Hartford. Both were water soaked.

| *Percentage amounts of* | 17883 | 18296 |
|---|---|---|
| Water | 67.04 | |
| Organic matter | 19.06 | |
| Mineral matter | 13.90 | |
| | 100.00 | |
| Nitrogen | .... | 1.47 |
| Phosphoric acid | 0.76 | 0.35 |
| [illegible] | [illegible] | [illegible] |

## PITTSBURG TANKAGE.

Made by the Pittsburg Reduction Co.

A small sample, **18294**, submitted by a prospective purchaser, was guaranteed to contain 2.3 per cent. of nitrogen, 2.3 per cent. of phosphoric acid and 0.7 per cent. of potash. The price was $9.00 per ton.

Analysis showed:

| *Percentage amounts of* | |
|---|---|
| Nitrogen | 2.09 |
| Phosphoric acid | 1.73 |
| Potash | 0.58 |
| Insoluble in acid | 26.76 |

The nitrogen of this material is probably not in a quickly available form. Its chief use would probably be as a "dryer" or "filler."

## PEAT AND SEWAGE.

**16092.** Sampled and sent by G. S. McNeill, Echo Farms Co., Litchfield.

ANALYSIS.

| *Percentage amounts of* | |
|---|---|
| Water | 55.80 |
| Nitrogen | 0.45 |
| Phosphoric acid | 0.13 |
| Potash | 0.05 |

This contains very considerably less fertilizing material than stable manure and that part of the nitrogen coming from the peat is but slowly available. Attempts to recover the fertilizing material from sewage are for the most part futile. Sewage is water containing only a few parts per thousand of matter having any value as a fertilizer and this is in part dissolved in the water and cannot be absorbed or taken out of solution by peat.

If exposed freely to air in contact with solid matter as in so-called "filtration beds" or "contact filters" the organic matter of sewage is oxidized, or burned, and destroyed. Organic nitrogen is converted into nitrates which are freely soluble in water and cannot be recovered from it, except by the roots of plants.

The water or sewage is thus made comparatively innocuous. If sewage stands, without contact with air, it forms a pestilent mess, evil smelling and dangerous, but not worth handling as a fertilizer if that were possible. When the sewage can be used *fresh* for irrigation, on properly constructed and managed

TOBACCO STEMS.

**16099.** Sampled and sent by P. D. Kibbe, Hartford, from a car-load bought from Cullman Bros., Milwaukee.

ANALYSIS

| *Percentage amounts of* | |
|---|---|
| Nitrogen | 1.85 |
| Phosphoric acid | 0.59 |
| Potash | 5.35 |

SPENT HOPS.

A sample of this material, **16265**, sampled and sent by Arthur Mather, Hartford, contained:

| *Percentage amounts of* | Spent hops. | N. Y. stable manure. |
|---|---|---|
| Water | 83.63 | 69.30 |
| Organic and volatile matter | 15.48 | 25.65 |
| Mineral matter | 0.89 | 5.05 |
| | 100.00 | 100.00 |
| *Nitrogen in organic matter* | *0.77* | *0.69* |
| Phosphoric acid in mineral matter | 0.18 | 0.67 |
| Potash | 0.88 | 1.06 |

A comparison with stable manure shows that the latter is considerably dryer and contains a good deal more phosphoric acid and potash. The hops, however, if they could be put on land at say half the price of manure, would be quite worth a trial as a source of humus, lacking in many soils, and of *nitrogen.*

GARBAGE TANKAGE.

**16738.** A single sample, sent from Waterbury, contained 3.44 per cent. of nitrogen.

SOOT.

**16139.** A sample of chimney soot sent by Bullard Machine Tool Co., Bridgeport, contained 0.50 per cent. of nitrogen.

PRECIPITATED PHOSPHATE.

**16751.** A sample of this material, used in the preparation of a special tobacco manure from which it was desired to exclude sulphates, was found to contain 7.65 per cent. of sulphuric acid.

SHEEP MANURE.

**16815.** Sampled and sent by Paul Thomson, West Hartford. Bought of W. M. Davidge & Co., New York, for $16.00 per ton.

| | |
|---|---|
| *Percentage amounts of* | |
| Water | 9.12 |
| Organic and volatile matter | 64.04 |
| Mineral matter | 26.84 |
| | 100.00 |
| In the organic matter, nitrogen | 2.36 |
| In the mineral matter, phosphoric acid | 2.15 |
| potash | 0.84 |
| sand | 10.92 |

PIGEON MANURE.

Two samples of this manure were sent by Chas. F. Whittemore, Brookdale Farm, West Suffield, and had the following composition:

| Station No. | 15924 | 16102 |
|---|---|---|
| *Percentage amounts of* | | |
| Water | 60.19 | 28.64 |
| Nitrogen | 2.59 | 2.93 |
| Phosphoric acid | 0.97 | 1.50 |
| Potash | 0.88 | 0.63 |

Sample **16102** was marked "dry" and shows considerably higher percentages of nitrogen and phosphoric acid than the fresh manure.

The nitrogen of poultry manure is quickly available and the material is generally regarded as a "hot" fertilizer and very rich in plant food. The analyses show that it has not very high percentage of either nitrogen, phosphoric acid, or potash.

FERTILIZER.

**17729.** A sample sent by Clarence Bryant, Windsor, from a lot offered as a fertilizer for gardens at 2 cents per pound. It consisted of ground shells such as are used for chicken feed.

## SUMMARY.

The cash retail cost in Connecticut of nitrogen in raw materials during 1906, as shown in previous pages, has been:—

| | Cost in cents per pound. Highest. | Lowest. | Average. |
|---|---|---|---|
| In *Nitrate of soda* | 18.3 | 15.6 | 17.3 |
| Dried blood | 21.8 | 15.7 | 18.6 |
| Cotton seed meal | 24.1 | 15.7 | 20.6 |
| Castor pomace | 23.3 | 17.5 | 21.1 |
| Linseed meal | 23.0 | 22.5 | 22.8 |

The corresponding price of water-soluble plus citrate-soluble phosphoric acid, in dissolved rock phosphate, has been:—

| Cost in cents per pound. Highest. | Lowest. | Average. |
|---|---|---|
| 4.8 | 4.2 | 4.6 |

The price of potash in raw materials has been:—

| | Highest. | Lowest. | Average. |
|---|---|---|---|
| In High grade carbonate | 7.7 | 6.8 | 7.2 |
| Cotton hull ashes | 12.9 | 7.7 | 10.1 |
| High grade sulphate | 5.3 | 4.9 | 5.1 |
| Double sulphate | 6.8 | 5.4 | 6.0 |
| Muriate | 4.8 | 4.1 | 4.4 |
| Kainit | .. | .. | 4.5 |

The price of lime, *per 100 pounds*, has been:—

| | Highest. | Lowest. | Average. |
|---|---|---|---|
| In Limestone or slaked lime | 103 | 46 | .. |
| Lime-kiln ashes | ... | .. | 92 |
| Wood ashes | ... | .. | 43 |

The price of factory mixed fertilizers bear no fixed relation to the amount of plant food in them.

For $30.00 there can be bought:—

| | Nitrogen, pounds. | Phosphoric Acid. pounds. | Potash. pounds. |
|---|---|---|---|
| *Nitrogenous superphosphates* | | | |
| In the best | 73 | 188 | 111 |
| In those of medium quality | 44 | 180 | 97 |
| In the least valuable | 23 | 279 | 53 |
| *Special manures* | | | |
| In the best | 69 | 170 | 143 |
| In those of medium quality | 47 | 174 | 112 |
| In the least valuable | 32 | 174 | 66 |
| *Home mixtures* | | | |
| In the average of all | 77 | 200 | 168 |

To do home-mixing to advantage it is necessary

1st. To get together.

2d. To begin seasonably.

3d. To get bids from a number of manufacturers.

4th. To buy in mixed car lots, for cash, with guaranty, and a rebate provided by the contract in case of failure to meet this guaranty.

5th. To do the mixing during the winter season.

In this way farmers may greatly reduce their fertilizer bills.

NEW HAVEN, January 15, 1907.

*To His Excellency, Rollin S. Woodruff, Governor of Connecticut:*

As required by law, this station respectfully submits to you the Eleventh Report on Food Products for the year ending July 31, 1906, by Dr. A. L. Winton.

Respectfully yours,

E. H. JENKINS, *Director.*

## PART II.

ELEVENTH

# REPORT ON FOOD PRODUCTS

BY A. L. WINTON.

This station is required by the food law to make examinations of food products suspected of adulteration, and to report to the dairy commissioner all cases of adulteration which are discovered. Under this law the sampling agent of the station has visited a considerable number of places and has bought a large number of samples which have been examined, and report to the dairy commissioner. An account of this work is given in the following pages.

The dairy commissioner and his deputy have sent a large number of samples of molasses, vinegar and butter, the sale of which is regulated by special statutes, as well as samples of other foods, which he is authorized to take under the food law. These are but briefly referred to in these pages, being discussed in his report, where account is also given of the results of prosecution under the law.

Lastly, a considerable number of samples of food products have been examined for individuals, which likewise receive brief mention here.

The larger part of the chemical work has been done by Mr. *Bailey, Miss Barber, Mr. Kreider and Mr. Shanley; the microscopic examinations have been largely carried out by Miss* Barber.

### MILK.

During the year covered by this Report, 657 samples have been examined, of which 362 were bought by the station agent from milk wagons, 116 were sent by health officers and 179 by consumers or dealers.

**Milk Sampled by the Station.**—The samples were collected chiefly during the months of August, 1906, following the system of inspection inaugurated in 1900.

Determinations of specific gravity, fat, total solids, solids not fat, and tests for preservatives and colors were made in each sample immediately after its arrival. A summary of the results obtained will be found in Table I; the names of the dealers and the analyses in Table II. The name which was on the milk cart was copied, but where no name appeared it was obtained from the driver. All names obtained in this latter way are marked with asterisks. The table also gives the specific gravity of the milk at 60° F., the first two figures, which are the same in all cases, being omitted. Thus 25.3 signifies a specific gravity of 1.0253. Next follow the percentages of fat, total solids, and solids not fat. Percentages of solids not fat below 8.5 and of fat below 3.25 are given in full-faced type.

These figures for solids not fat, and fat, are the standards of milk adopted by the Association of Official Agricultural Chemists, by the U. S. Secretary of Agriculture and by this Station, as provided in Section 2575 of the General Statutes. Lastly, the table shows the results of tests for preservatives.

*Skimmed and Watered Milk.*—Percentages printed in full-faced type indicate that the samples are of inferior quality as regards these constituents, but not necessarily that they have been adulterated. It is well known that genuine milk has a very wide range of composition, caused by differences of breed, feed, period of lactation and many other things, and it is also true that milk which has not been skimmed or watered is sometimes so poor as to be unfit for sale as whole milk. Laws regulating the sale of milk should be so devised as to exclude the sale of milk, as of standard quality, which is very inferior in its food value, even if it has not been adulterated.

Again it should be noted that the pint samples were taken, *from milk cans by the milkmen and not* by *our agent.* Milkmen do not always mix the contents of their cans before dipping, and the result of this carelessness is that some customers get more than their share of cream, while others get an inferior milk. The results given in the table represent the exact quality of the samples and not necessarily that of the whole contents of the milk can. They also represent what a customer, who paid the price of whole milk, received for his money.

Whole milk generally has a specific gravity at 60° F. between 1.029 and 1.033. Exceptionally rich milk with a high percentage of fat, however, may have a specific gravity lower than 1.029, and by that test alone would be unjustly condemned. Addition of water to milk lowers, and skimming raises, the specific gravity. Low percentages of fat, solids not fat, and total solids, and low specific gravity indicate that the milk has been watered, but when a deficiency of fat and total solids is associated with a normal percentage of solids not fat and a high specific gravity, the milk has probably been skimmed. Samples which have been both skimmed and watered and which are very deficient in fat and solids may have a normal specific gravity as the two operations have opposite effects on this physical property of milk.

There are then two reasons why a sample should not be judged by its specific gravity alone: first, exceptionally rich milk might be condemned, and second, milk which has been both skimmed and watered might pass as genuine. Taken in connection with the results of chemical analysis, the determination of specific gravity is, however, of great value.

The following samples were watered:

16934 H. Ross, No. 10, Bridgeport.
17085 F. H Wells,* Long Hill, Bridgeport.
17184 O. W. Starr,* Danbury.
17053 H. Rosenberg, No. 81, Hartford.
17054 G. Toci, No. 190, Hartford.
17069 M. B. & F. S. Hubbell, New Haven.
16917 M. Roberts, Old Reliable Dairy, Norwalk.
16921 David Jenks, Belden Hill Dairy, South Norwalk.
17039 W. I. Emmons, No. 303, Waterbury.

The following were considerably below standard and were unfit for sale as standard milk.

17088 H. G. Foote,* Bridgeport.
16956 J. F. Anglum, No. 146, Hartford.
17073 F. J. Buck, New Haven.
16999 J. F. Dunn, New Haven.
16991 Sunnyside Farm, No. 89, New Haven.
17019 S. B. Wicks, Cloverleaf Dairy, New London.

*Preservatives.*—The addition of boric acid (often in the form of borax) or formaldehyde to milk is a serious menace to the health of consumers, particularly infants and invalids, and

can not be too strongly condemned. This form of adulteration is dangerous, not only because of the physiological action of the chemicals themselves, but because their use becomes a

TABLE I.—SUMMARY OF ANALYSES OF MILK BOUGHT BY THE STATION OF MILKMEN, 1906.

| Place. | Total number of samples. | Below twelve per cent. of total solids. | Below eight and one-half per cent. of solids not fat. | Below three and one-quarter per cent. of fat. | Contain boric acid (borax). | Contain formaldehyde. | Colored with anatto | Colored with coal-tar dye. |
|---|---|---|---|---|---|---|---|---|
| Branford | 12 | 4 | 7 | 1 | 2 | 0 | 0 | 0 |
| Bridgeport | 40 | 16 | 30 | 3 | 0 | 0 | 0 | 0 |
| Bristol | 11 | 1 | 5 | 0 | 0 | 0 | 0 | 0 |
| Danbury | 15 | 10 | 11 | 1 | 0 | 0 | 0 | 0 |
| Derby | 13 | 3 | 10 | 0 | 0 | 0 | 0 | 0 |
| Forestville | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hartford | 38 | 8 | 20 | 4 | 0 | 0 | 0 | 0 |
| Meriden | 16 | 2 | 5 | 0 | 0 | 0 | 0 | 0 |
| Middletown | 22 | 2 | 8 | 1 | 0 | 0 | 0 | 0 |
| New Britain | 21 | 3 | 5 | 1 | 0 | 0 | 0 | 0 |
| New Haven | 44 | 20 | 32 | 9 | 0 | 0 | 0 | 0 |
| New London | 20 | 6 | 9 | 1 | 0 | 0 | 0 | 0 |
| Norwalk | 6 | 2 | 2 | 0 | 0 | 0 | 0 | 0 |
| Norwich | 14 | 6 | 9 | 0 | 0 | 0 | 0 | 0 |
| Plainville | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Plantsville | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rockville | 4 | 1 | 3 | 0 | 0 | 0 | 0 | 0 |
| South Norwalk | 10 | 1 | 4 | 1 | 0 | 0 | 0 | 0 |
| Southington | 5 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Stamford | 16 | 4 | 10 | 0 | 0 | 0 | 0 | 0 |
| Wallingford | 16 | 3 | 8 | 0 | 0 | 0 | 0 | 0 |
| Waterbury | 19 | 6 | 8 | 2 | 0 | 0 | 0 | 0 |
| Willimantic | 17 | 5 | 7 | 2 | 0 | 0 | 0 | 0 |
| Total for 1906 | 362 | 104 | 194 | 26 | 2 | 0 | 0 | 0 |
| " 1905 | 228 | 78 | 131 | 15 | 0 | 1 | 0 | 0 |
| " 1904 | 316 | 108 | 185 | 31 | 2 | 5 | 5 | 2 |
| " 1902 | 292 | 80 | 130 | 22 | 1 | 3 | 4 | 3 |
| " 1901 | 375 | 109 | 190 | 43 | 2 | 7 | * | * |
| " 1900 | 246 | 54 | 100 | 34 | 7 | 14 | * | * |

* *No tests for colors were made in 1900 and 1901.*

substitute for the cleanliness and sanitary precautions which are so essential to the healthfulness of the product.

Only two samples, both from one dealer, contained a preservative. These were Nos. 16873 and 16874, bought of J. E. Palmer, Branford, which contained boric acid.

*Artificial Coloring Matter.*—These colors give to "blue" milk, whether skimmed or of naturally inferior quality, a yellow tint resembling that of rich milk, thus producing directly the opposite effect of indigo or other blue colors which are used in the laundry to destroy the yellowish tinge in linen or cotton. Anatto, a well-known vegetable product, has for years served as a butter color. The coal-tar dye commonly used in milk is soluble in water, thus differing from the related dye used as a butter color, which is insoluble in water but soluble in oil.

As appears from Table I, 7 samples in 1902 and 7 in 1904 contained either anatto or a coal-tar color, but no color was detected in any sample during the past two years.

**Milk Sampled by Health Officers.**—Mr. L. C. Root, Milk Inspector of the City of Stamford, has delivered at the station in person, at intervals during the year, samples of milk taken in his capacity as inspector. In all 82 samples were examined for Mr. Root, of which 6 were unquestionably watered, 3 were skimmed, and 1 contained formaldehyde. Thirty-one others were below standard in either fat or solids not fat or both.

Thirty-four samples have been examined for Dr. E. A. McLellan, Health Officer, Bridgeport. The milk was collected and delivered at the station by Mr. D. W. Lynch, Milk Inspector. One sample was watered, 2 were skimmed, and 16, although of better quality, were somewhat below standard.

**Milk Sampled by Consumers and Dealers.**—One hundred and seventy-nine samples sent by consumers and dealers have been tested. The results are not of general interest.

## CREAM.

Three samples sent by the Dairy Commissioner were not found adulterated. Of 22 sent by private citizens one was preserved by boric acid and one contained 11 per cent. of fat and was therefore below standard.

## TABLE II.—MILK BOUGHT BY THE STATION OF MILKMEN.

| | Sampled. | Dealer. | Specific gravity at 60° F. | Total solids. | Solids not fat. | Fat. | Pr |
|---|---|---|---|---|---|---|---|
| | | *Branford.* | | % | % | % | |
| 65 | July 31 | H. G. Baldwin | 27.8 | 11.09 | 7.49 | 3.6 | N |
| 70 | Aug. 8 | H. G. Baldwin* | 30.1 | 12.04 | 8.34 | 3.7 | |
| 66 | July 31 | John Erickson* | 29.9 | 12.18 | 8.18 | 4.0 | |
| 71 | Aug. 8 | J. E. Palmer* | 30.7 | 12.81 | 8.71 | 4.1 | |
| 72 | 8 | J. E. Palmer* | 33.1 | 13.61 | 9.21 | 4.4 | |
| 73 | 8 | J. E. Palmer* | 27.9 | 11.76 | 7.76 | 4.0 | Bo |
| 74 | 8 | J. E. Palmer* | 28.4 | 12.02 | 7.82 | 4.2 | |
| 01 | July 31 | Robert Stent* | 31.0 | 13.03 | 8.63 | 4.4 | N |
| 00 | 31 | A. Struszenski | 30.5 | 12.74 | 8.44 | 4.3 | |
| 67 | 31 | Herbert Sykes* | 31.9 | 11.79 | 8.69 | 3.1 | |
| 68 | Aug. 8 | Herbert Sykes* | 31.4 | 11.89 | 8.49 | 3.4 | |
| 69 | 8 | John Zawalick* | 29.3 | 13.58 | 8.68 | 4.9 | |
| | | *Bridgeport.* | | | | | |
| 24 | Aug. 14 | David Abbott, No. 7* | 27.6 | 12.92 | 8.32 | 4.6 | |
| 86 | 24 | G. A. Barhite* | 29.6 | 12.54 | 8.54 | 4.0 | |
| 36 | 24 | E. R. Burr, No. 149* | 30.6 | 14.11 | 9.11 | 5.0 | |
| 27 | 14 | E. C. Burroughs | 28.6 | 11.99 | 8.19 | 3.8 | |
| 27 | 24 | L. E. Burroughs | 28.6 | 14.67 | 8.37 | 6.3 | |
| 28 | 24 | E. W. Dewhurst & Son | 30.1 | 11.54 | 8.44 | 3.1 | |
| 84 | 24 | W. E. Dishrow | 25.4 | 11.34 | 7.54 | 3.8 | |
| 33 | 14 | Gus. Folk, No. 38 | 27.8 | 11.65 | 7.95 | 3.7 | |
| 88 | 24 | H. G. Foote* | 30.0 | 10.71 | 8.31 | 2.4 | |
| 87 | 24 | Clark Grumman* | 29.9 | 12.64 | 8.54 | 4.1 | |
| 35 | 14 | A. W. Hall, No. 144 | 28.6 | 11.72 | 8.02 | 3.7 | |
| 91 | 24 | L. A. Jennings* | 30.0 | 12.03 | 8.43 | 3.6 | |
| 30 | 24 | F. Kaechele | 28.7 | 11.40 | 8.10 | 3.3 | |
| 34 | 24 | G. Kaechele, No. 152 | 28.3 | 11.06 | 7.96 | 3.1 | |
| 41 | 14 | J. E. Macdonald & Son | 31.0 | 11.97 | 8.17 | 3.8 | |
| 39 | 14 | G. Machalowski, No. 5, White Plains Dairy, Trumbull | 29.2 | 12.24 | 8.24 | 4.0 | |
| 37 | 24 | L. Machalowski & Son, Trumbull | 29.6 | 12.30 | 8.30 | 4.0 | |
| 40 | 14 | Geo. L. McClellan, Nichols, No. 32 | 30.3 | 12.10 | 8.30 | 3.8 | |
| 31 | 24 | C. G. Miller, No. 80* | 30.1 | 12.85 | 8.75 | 4.1 | |
| 22 | 14 | The Nickle Plate Dairy | 31.0 | 13.66 | 8.96 | 4.7 | |
| 28 | 14 | J. J. Niedermier, No. 57 | 30.5 | 12.89 | 8.59 | 4.3 | |
| 30 | 14 | H. W. Parks, No. 33* | 28.6 | 12.87 | 8.27 | 4.6 | |
| 26 | 14 | *C. Pauls, No. 14* | 26.2 | 10.86 | 7.16 | 3.7 | |
| 31 | 14 | Howard Randall, No. 40* | 29.8 | 12.71 | 8.61 | 4.1 | |
| 33 | 24 | The Roger Farm Dairy, No. 115 | 32.4 | 12.38 | 8.98 | 3.4 | |
| 34 | 14 | H. Ross, No. 10 | 23.6 | 10.67 | 6.87 | 3.8 | |
| 25 | 14 | Andrew Roswell, No. 58* | 28.8 | 12.04 | 8.04 | 4.0 | |
| 29 | 14 | J. Rundecker & Sons, No. 84 | 30.5 | 12.74 | 8.44 | 4.3 | |
| 23 | 14 | R. F. Schmitt, No. 67* | 30.8 | 12.31 | 8.51 | 3.8 | |
| 32 | 24 | *Chas. Sherwood, No. 143, Woodshire Farm* | 29.7 | 13.87 | 8.67 | 5.2 | |
| 36 | 14 | John G. Smith, No. 50* | 28.1 | 11.89 | 7.89 | 4.0 | |
| 37 | 14 | Star Farm Dairy, No. 11 | 29.9 | 12.77 | 8.57 | 4.2 | |
| 35 | 24 | S. S. Walker, No. 26, Long Hill | 31.0 | 13.56 | 9.26 | 4.3 | |
| 38 | 14 | John Weller, No. 16* | 30.5 | 13.11 | 8.61 | 4.5 | |

TABLE II.—MILK BOUGHT BY THE STATION OF MILKMEN—*Continu*

| | Sampled. | Dealer. | Specific gravity at 60° F. | Total solids. | Solids not fat. | Fat. | F |
|---|---|---|---|---|---|---|---|
| | | *Bridgeport.* | | % | % | % | |
| 85 | Aug. 24 | F. H. Wells, Long Hill* | 22.3 | 9.96 | 6.36 | 3.6 | |
| 89 | 24 | L. E. Williams | 30.3 | 11.76 | 8.46 | 3.3 | |
| 90 | 24 | Geo. Wilson* | 27.1 | 11.88 | 7.88 | 4.0 | |
| 129 | 24 | J. Wilson* | 29.2 | 13.00 | 8.60 | 4.4 | |
| 138 | 24 | A. Wolf, No. 146* | 29.6 | 12.20 | 8.20 | 4.0 | |
| 932 | 14 | Jos. Zbytniewski, No. 168* | 31.5 | 13.16 | 8.96 | 4.2 | |
| | | *Bristol.* | | | | | |
| 241 | Sept. 5 | Joe Blean* | 31.4 | 13.12 | 8.92 | 4.2 | |
| 248 | 5 | C. E. Gaylord, Hillside Farm | 29.7 | 12.22 | 8.32 | 3.9 | |
| 242 | 5 | Holt & Bradbury | 30.0 | 12.61 | 8.41 | 4.2 | |
| 246 | 5 | Holt & Bradbury | 29.7 | 14.53 | 8.43 | 6.1 | |
| 243 | 5 | Manchester Bros. | 31.7 | 13.64 | 9.04 | 4.6 | |
| 250 | 5 | Manchester Bros. | 30.3 | 12.47 | 8.47 | 4.0 | |
| 245 | 5 | William Miller* | 30.6 | 13.85 | 8.95 | 4.9 | |
| 244 | 5 | S. D. Newell | 31.4 | 13.46 | 8.96 | 4.5 | |
| 240 | 5 | A. G. Root | 30.1 | 14.04 | 8.74 | 5.3 | |
| 249 | 5 | James L. Wilcox, Clover Dairy | 31.3 | 13.97 | 9.17 | 4.8 | |
| 247 | 5 | F. H. Wood* | 28.3 | 11.47 | 7.77 | 3.7 | |
| | | *Danbury.* | | | | | |
| 7171 | Aug. 29 | G. H. Bard* | 25.3 | 10.76 | 7.16 | 3.6 | |
| 7172 | 29 | City Creamery, 11 New st. | 28.4 | 11.42 | 7.92 | 3.5 | |
| 7175 | 29 | City Creamery, 11 New st. | 28.8 | 11.46 | 7.86 | 3.6 | |
| 7174 | 29 | Danbury Milk Sterilizing Co. | 28.1 | 11.44 | 7.84 | 3.6 | |
| 7176 | 29 | Danbury Milk Sterilizing Co. | 28.6 | 11.55 | 7.85 | 3.7 | |
| 7178 | 29 | J. R. Hatch | 27.5 | 10.98 | 7.68 | 3.3 | |
| 7170 | 29 | Egbert Haviland* | 30.7 | 11.91 | 8.51 | 3.4 | |
| 7179 | 29 | Henry Hokenson* | 30.1 | 13.00 | 8.70 | 4.3 | |
| 7177 | 29 | L. T. Jennings, Hayestown Dairy | 29.1 | 12.57 | 8.47 | 4.1 | |
| 7183 | 29 | O. A. Johnson | 27.0 | 11.00 | 7.60 | 3.4 | |
| 7182 | 29 | A. Mishico* | 31.5 | 12.15 | 8.75 | 3.4 | |
| 7181 | 29 | F. Mongillo* | 26.5 | 11.81 | 7.71 | 4.1 | |
| 7173 | 29 | Geo. Rundle | 30.3 | 12.19 | 8.49 | 3.7 | |
| 7180 | 29 | S. F. Sanford* | 28.9 | 13.13 | 8.53 | 4.6 | |
| 7184 | 29 | O. W. Starr* | 20.0 | 8.50 | 5.80 | 2.7 | |
| | | *Derby.* | | | | | |
| 6878 | Aug. 9 | Geo. Burgess* | 29.2 | 12.26 | 8.16 | 4.1 | |
| 6875 | 9 | D. H. Clark | 29.8 | 12.20 | 8.40 | 3.8 | |
| 6876 | 9 | C. D. Dimon* | 28.2 | 12.30 | 8.00 | 4.3 | |
| 6886 | 9 | E. Goodman* | 28.3 | 11.77 | 7.67 | 4.1 | |
| 6885 | 9 | M. W. Johnson, Monroe | 30.8 | 13.12 | 8.52 | 4.6 | |
| 6884 | 9 | H. Karnath* | 30.7 | 12.51 | 8.41 | 4.1 | |
| 6887 | 9 | McConnery Bros.* | 29.4 | 12.32 | 8.32 | 4.0 | |
| 6879 | 9 | G. Muscarello* | 30.9 | 13.11 | 8.61 | 4.5 | |
| 6882 | 9 | F. C. Nichols* | 25.2 | 12.00 | 7.10 | 4.9 | |
| 6880 | 9 | Rau Bros.* | 29.5 | 12.59 | 8.09 | 4.5 | |
| [illegible] | [illegible] | Rau Bros. | 25.8 | 10.83 | 6.93 | 3.9 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 4.6 | |

TABLE II.—MILK BOUGHT BY THE STATION OF MILKMEN—*Continu*

| Station No. | Sampled. | | Dealer. | Specific gravity at 60° F. | Total solids. | Solids not fat. | Fat. | P |
|---|---|---|---|---|---|---|---|---|
| | | | *Forestville.* | | % | % | % | |
| 251 | Sept. | 5 | W. A. Hyde | 31.1 | 13.50 | 8.70 | 4.8 | ] |
| | | | *Hartford.* | | | | | |
| 049 | Aug. | 22 | P. Andresen, No. 24 | 29.4 | 11.82 | 8.22 | 3.6 | |
| 956 | | 15 | J. F. Anglum, No. 146 | 29.6 | 10.60 | 8.30 | 2.3 | |
| 957 | | 22 | W. W. Barber, No. 67 | 30.3 | 12.40 | 8.60 | 3.8 | |
| 945 | | 15 | I. Berkowitz, No. 112 | 27.2 | 11.59 | 7.79 | 3.8 | |
| 945 | | 22 | M. O. Bradstreet, No. 105 | 29.5 | 12.69 | 8.49 | 4.2 | |
| 946 | | 15 | O. & H. Chapman, No. 58 | 27.7 | 12.20 | 7.90 | 4.3 | |
| 948 | | 15 | C. J. Christensen, No. 109 | 30.3 | 12.57 | 8.57 | 4.0 | |
| 955 | | 22 | D. Davison, West Hartford* | 29.9 | 12.51 | 8.41 | 4.1 | |
| 953 | | 15 | J. Donahue, No. 16 | 26.7 | 11.06 | 7.86 | 3.2 | |
| 959 | | 22 | W. H. Egan, No. 82 | 30.3 | 12.49 | 8.39 | 4.1 | |
| 952 | | 22 | H. I. Epstein, No. 106 | 28.6 | 12.34 | 8.04 | 4.3 | |
| 954 | | 15 | Wm. P. Francis, No. 150 | 31.0 | 13.52 | 9.02 | 4.5 | |
| 943 | | 15 | The Hartford Dairy Co. | 29.8 | 12.60 | 8.60 | 4.0 | |
| 949 | | 15 | The Hartford Dairy Co. | 29.7 | 12.32 | 8.42 | 3.9 | |
| 943 | | 22 | The Hartford Dairy Co. | 29.6 | 12.60 | 8.70 | 3.9 | |
| 956 | | 22 | H. W. Holcomb, No. 26 | 29.4 | 11.66 | 8.26 | 3.4 | |
| 952 | | 15 | C. H. Horton, No. 21 | 31.1 | 13.94 | 8.84 | 5.1 | |
| 951 | | 15 | H. Hubbard, No. 124 | 29.7 | 12.84 | 8.64 | 4.2 | |
| 946 | | 22 | J. A. Jensen, No. 78 | 30.1 | 13.54 | 8.74 | 4.8 | |
| 959 | | 15 | Otto Jensen, No. 23 | 29.6 | 12.26 | 8.66 | 3.6 | |
| 950 | | 22 | Peter Jepsen, No. 132 | 30.9 | 12.80 | 8.60 | 4.2 | |
| 960 | | 15 | I. Kulakowski, No. 199 | 30.6 | 12.98 | 8.78 | 4.2 | |
| 942 | | 15 | J. Levin, No. 69 | 29.9 | 12.74 | 8.54 | 4.2 | |
| 942 | | 22 | J. Levin, No. 69 | 30.4 | 13.07 | 8.87 | 4.2 | |
| 947 | | 15 | Levin & Klienman, No. 200 | 29.4 | 13.57 | 8.57 | 5.0 | |
| 958 | | 22 | C. Nelsen, No. 85 | 26.8 | 12.12 | 7.92 | 4.2 | |
| 958 | | 15 | M. Pomeranz, No. 39 | 29.4 | 12.94 | 8.44 | 4.5 | |
| 944 | | 15 | Ch. Rosen, No. 184 | 30.8 | 12.70 | 8.80 | 3.9 | |
| 948 | • | 22 | C. Rosenberg* | 30.3 | 11.81 | 8.21 | 3.6 | |
| 955 | | 15 | H. Rosenberg, No. 81 | 31.1 | 12.54 | 9.04 | 3.5 | |
| 953 | | 22 | H. Rosenberg, No. 81 | 26.2 | 9.76 | 7.16 | 2.6 | |
| 944 | | 22 | Edward Rowett, No. 66* | 28.4 | 14.84 | 8.84 | 6.0 | |
| 960 | | 22 | L. A. St. John | 28.9 | 13.03 | 8.43 | 4.6 | |
| 947 | | 22 | L. W. Seymour, No. 20 | 30.5 | 12.00 | 8.40 | 3.6 | |
| 954 | | 22 | G. Toci, No. 190 | 26.1 | 10.36 | 7.36 | 3.0 | |
| 950 | | 15 | A. B. Waterman | 28.7 | 12.25 | 8.35 | 3.9 | |
| 957 | | 15 | C. E. Welles | 29.1 | 13.40 | 8.40 | 5.0 | |
| 951 | | 22 | M. G. Whitham, No. 88 | 30.5 | 13.26 | 8.76 | 4.5 | |
| | | | *Meriden.* | | | | | |
| 97 | Aug. | 30 | John Britney* | 30.6 | 12.10 | 8.50 | 3.6 | |
| 93 | | 30 | W. D. F. Cook | 30.2 | 13.73 | 8.73 | 5.0 | |
| 92 | | 30 | B. F. Deming | 29.9 | 13.31 | 8.91 | 4.4 | |
| 91 | | 30 | Dickerman Bros. | 31.0 | 12.55 | 8.85 | 3.7 | |
| 96 | | 30 | F. A. Disbrow | 30.9 | 12.21 | 8.81 | 3.4 | |
| 90 | | 30 | A. Hendricks* | 26.0 | 12.19 | 7.59 | 4.6 | |
| 85 | | 30 | D. Higgins | 29.3 | 11.75 | 8.15 | 3.6 | |

'ABLE II.—MILK BOUGHT BY THE STATION OF MILKMEN—*Continuea*

| Sampled. | | Dealer. | Specific gravity at 60° F. | Total solids. | Solids not fat. | Fat. | Pres- tiv |
|---|---|---|---|---|---|---|---|
| | | *Meriden.* | | % | % | % | |
| Aug. | 30 | D. Higgins | 29.1 | 12.69 | 8.49 | 4.2 | No |
| | 30 | W. Hyott | 31.2 | 12.43 | 8.83 | 3.6 | " |
| | 30 | L. L. Johnson | 30.7 | 12.50 | 8.60 | 3.9 | " |
| | 30 | Nowak Bros. & Co. | 31.7 | 12.99 | 8.99 | 4.0 | " |
| | 30 | Nowak Bros. & Co.* | 31.3 | 13.30 | 9.10 | 4.2 | " |
| | 30 | G. Schlaak | 29.2 | 11.90 | 8.30 | 3.6 | " |
| | 30 | W. G. Schwink, Maple Scatter Dairy | 28.5 | 13.31 | 8.41 | 4.9 | " |
| | 30 | H. A. Sibley* | 29.3 | 13.25 | 8.65 | 4.6 | " |
| | 30 | Anto Verno* | 31.4 | 13.58 | 8.98 | 4.6 | " |
| | | *Middletown.* | | | | | |
| Aug. | 31 | F. B. Ashton | 28.7 | 13.59 | 8.49 | 5.1 | " |
| | 31 | C. E. Bacon | 29.9 | 11.57 | 8.17 | 3.4 | " |
| | 31 | A. M. Brock* | 30.8 | 13.75 | 8.95 | 4.8 | " |
| | 31 | T. Coleman* | 30.9 | 12.11 | 8.51 | 3.6 | " |
| | 31 | Daniels Bros., Millbrook Farm | 30.1 | 12.28 | 8.48 | 3.8 | " |
| | 31 | Chas. Davis | 28.8 | 12.67 | 8.27 | 4.4 | " |
| | 31 | R. Davis | 25.9 | 15.54 | 8.14 | 7.4 | " |
| | 31 | Robert Dunn* | 31.1 | 12.84 | 8.84 | 4.0 | " |
| | 31 | A. W. Gilbert | 29.8 | 12.55 | 8.55 | 4.0 | " |
| | 31 | Wm. H. Harris | 29.3 | 13.76 | 8.56 | 5.2 | " |
| | 31 | F. O. Jackson* | 29.6 | 12.17 | 8.47 | 3.7 | " |
| | 31 | F. O. Jackson | 30.5 | 12.89 | 8.69 | 4.2 | " |
| | 31 | Johnson Bros.* | 29.7 | 13.44 | 8.64 | 4.8 | " |
| | 31 | Frank Jones* | 30.8 | 12.64 | 8.84 | 3.8 | " |
| | 31 | Lee Bros. | 29.8 | 13.59 | 8.69 | 4.9 | " |
| | 31 | H. E. Merrill, Cromwell | 29.2 | 13.90 | 8.50 | 5.4 | " |
| | 31 | C. C. Plum | 29.4 | 12.37 | 8.37 | 4.0 | " |
| | 31 | E. H. Plum | 30.0 | 13.44 | 8.64 | 4.8 | " |
| | 31 | E. J. Roberts | 29.4 | 12.56 | 8.46 | 4.1 | " |
| | 31 | L. M. Tucker, Cedar Hill Dairy | 30.1 | 11.56 | 8.56 | 3.0 | " |
| | 31 | L. M. Tucker, Cedar Hill Dairy | 30.4 | 12.75 | 8.95 | 3.8 | " |
| | 31 | Fred Zens | 30.6 | 12.87 | 8.87 | 4.0 | " |
| | | *New Britain.* | | | | | |
| Aug. | 16 | S. Appell, No. 156 | 28.9 | 12.49 | 8.29 | 4.2 | " |
| | 16 | J. B. Atwater | 30.4 | 13.50 | 8.80 | 4.7 | " |
| | 16 | Chas. Bahadoorigan, Stanley Quarter* | 21.0 | 11.20 | 6.50 | 4.7 | " |
| | 16 | H. P. Battey, No. 1 | 30.3 | 12.74 | 8.44 | 4.3 | " |
| | 16 | Cedar Hill Farm Dairy, No. 21 | 29.5 | 13.29 | 8.69 | 4.6 | " |
| | 16 | E. A. Elliott, No. 16 | 30.8 | 13.06 | 8.86 | 4.2 | " |
| | 16 | F. J. Elton, No. 7 | 28.4 | 12.34 | 8.14 | 4.2 | " |
| | 16 | C. E. Flood, No. 33 | 29.9 | 12.66 | 8.36 | 4.3 | " |
| | 16 | A. Hansen, No. 78* | 31.6 | 13.34 | 9.14 | 4.2 | " |
| | 16 | C. F. Johnson, No. 34 | 30.4 | 13.34 | 8.74 | 4.6 | " |
| | 16 | Edw. Lundell, No. 41 | 30.5 | 13.39 | 8.89 | 4.5 | " |
| | 16 | Howard Mehan | 30.5 | 11.53 | 8.53 | 3.0 | " |
| | 16 | Donald McMahan, No. 131* | 25.8 | 11.24 | 7.34 | 3.9 | " |
| | 16 | I. J. Newton, No. 62 | 29.3 | 12.72 | 8.52 | 4.2 | " |
| | 16 | M. A. Pabst, No. 127 | 29.2 | 14.60 | 8.80 | 5.8 | " |

TABLE II.—MILK BOUGHT BY THE STATION OF MILKMEN—*Continue*

| | Sampled. | | Dealer. | Specific gravity at 60° F. | Total solids. | Solids not fat. | Fat. | Pre… |
|---|---|---|---|---|---|---|---|---|
| | | | *New Britain.* | | % | % | % | |
| 6 | Aug. | 16 | St. Beller, No. 155 | 30.8 | 13.38 | 8.98 | 4.4 | N |
| 0 | | 16 | Seibert's Center View Farm, No. 45 | 29.9 | 13.45 | 8.65 | 4.8 | |
| 5 | | 16 | Jos. Shapiro, No. 125* | 29.3 | 12.91 | 8.61 | 4.3 | |
| 1 | | 16 | T. Tuszkowski, No. 115 | 31.5 | 14.39 | 9.29 | 5.1 | |
| 2 | | 16 | Geo. Van Epps, No. 101 | 28.9 | 13.33 | 8.63 | 4.7 | |
| 9 | | 16 | J. H. Weymouth, No. 2* | 29.6 | 12.72 | 8.52 | 4.2 | |
| | | | *New Haven.* | | | | | |
| 9 | Aug. | 17 | Geo. G. Allen | 30.5 | 12.66 | 8.66 | 4.0 | |
| 0 | | 23 | J. E. Bishop & Sons | 31.0 | 12.25 | 8.65 | 3.6 | |
| 5 | | 17 | Geo. J. Borst, No. 46 | 29.1 | 11.93 | 8.13 | 3.8 | " |
| | | 17 | G. C. Bradley, No. 11 | 29.3 | 12.01 | 8.11 | 3.9 | " |
| 7 | | 17 | C. W. Brock | 30.5 | 12.58 | 8.38 | 4.2 | " |
| 7 | | 23 | C. W. Brock, Whitneyville | 28.6 | 12.43 | 8.23 | 4.2 | " |
| 3 | | 23 | F. J. Buck | 28.5 | 10.42 | 7.62 | 2.8 | " |
| | | 17 | Cherry Hill Dairy, No. 107 | 30.5 | 12.79 | 8.59 | 4.2 | " |
| 3 | | 17 | Clover Dairy Creamery | 30.2 | 12.85 | 8.55 | 4.3 | " |
| 5 | | 23 | A. Daly, No. 35 | 29.9 | 12.00 | 8.40 | 3.6 | " |
| 3 | | 17 | W. H. Davis, No. 103 | 30.8 | 11.90 | 8.40 | 3.5 | " |
| 2 | | 23 | Chas. C. Dudley, No. 47 | 29.3 | 11.22 | 8.02 | 3.2 | " |
| 9 | | 17 | J. F. Dunn | 27.8 | 10.21 | 7.51 | 2.7 | " |
| 3 | | 23 | J. F. Dunn | 28.6 | 11.83 | 8.03 | 3.8 | " |
| | | 17 | E. C. Goodrich, No. 102 | 30.1 | 12.57 | 8.57 | 4.0 | " |
| | | 17 | Greene Bros., No. 50 | 30.1 | 11.41 | 8.31 | 3.1 | " |
| | | 23 | Green's Dairy Farm, No. 17 | 28.4 | 11.07 | 7.87 | 3.2 | " |
| | | 23 | C. E. Hall, No. 61 | 29.0 | 12.57 | 8.37 | 4.2 | " |
| | | 23 | G. B. Hall, No. 137 | 30.1 | 12.17 | 8.37 | 3.8 | " |
| | | 23 | L. G. Hemingway, No. 44 | 30.6 | 11.37 | 8.27 | 3.1 | " |
| | | 17 | Geo. Hine, No. 43, Montowese* | 28.5 | 11.68 | 7.98 | 3.7 | " |
| | | 17 | B. N. Hosley | 31.0 | 12.23 | 8.73 | 3.5 | " |
| | | 23 | M. B & F. S. Hubbell | 21.7 | 9.11 | 6.21 | 2.9 | " |
| | | 17 | Michael Inack, No. 27* | 28.0 | 11.82 | 7.92 | 3.9 | " |
| | | 23 | Wm. Kipp, No. 122 | 29.9 | 11.21 | 8.31 | 2.9 | " |
| | | 23 | D. Krall, No. 30 | 31.3 | 12.49 | 8.89 | 3.6 | " |
| | | 17 | Wilson H. Lee, Fairlea Farm | 30.9 | 13.88 | 8.88 | 5.0 | " |
| | | 23 | J. Loveday, No. 49, Elm Tree Dairy | 30.7 | 12.66 | 8.66 | 4.0 | " |
| | | 23 | A. M. Merrell, Highlawn | 28.6 | 11.58 | 7.98 | 3.6 | " |
| | | 23 | H. G. Meserole | 27.5 | 10.79 | 7.49 | 3.3 | " |
| | | 23 | The R. H. Nesbit Co. | 31.3 | 12.58 | 8.68 | 3.9 | " |
| | | 17 | New Haven Dairy | 30.0 | 12.26 | 8.36 | 3.9 | " |
| | | 17 | L. C. Palmer, No. 45 | 30.1 | 12.08 | 8.38 | 3.7 | " |
| | | 23 | W. C. Russell, No. 141, Tyler City | 31.0 | 13.06 | 8.76 | 4.3 | " |
| | | 17 | R. A. Scholz, No. 113 | 28.8 | 12.04 | 8.24 | 3.8 | " |
| | | 17 | A. B. Sperry, No. 29* | 30.1 | 11.86 | 8.26 | 3.6 | " |
| | | 23 | Spring Glen Farm, J. I. Webb, Mgr. | 29.8 | 12.30 | 8.30 | 4.0 | " |
| | | 17 | Sunnyside Farm, No. 89 | 27.6 | 10.12 | 7.52 | 2.6 | " |
| | | 23 | C. E. Thatcher, No. 147 | 28.0 | 11.40 | 7.80 | 3.6 | " |
| | | 17 | F. A. Vining | 29.8 | 13.38 | 8.58 | 4.8 | " |
| | | 23 | M. Walley, No. 147 | 30.4 | 11.45 | 8.25 | 3.2 | " |
| | | 23 | H. Weinstein, No. 124 | 29.3 | 12.10 | 8.40 | 3.7 | " |

'ABLE II.—MILK BOUGHT BY THE STATION OF MILKMEN—*Continue.*

| Sampled. | | Dealer. | Specific gravity at 60° F. | Total solids. | Solids not fat. | Fat. | Pres ti |
|---|---|---|---|---|---|---|---|
| | | *New London.* | | % | % | % | |
| Aug. | 20 | J. Ackerman* | 31.5 | 12.36 | 8.66 | 3.7 | N |
| | 20 | A. T. Avery | 30.1 | 11.86 | 8.36 | 3.5 | |
| | 20 | W. H. Benham, Riverside Dairy | 29.3 | 14.22 | 8.62 | 5.6 | |
| | 20 | J. Bliven* | 31.4 | 13.69 | 9.09 | 4.6 | |
| | 20 | Brookside Farm | 29.1 | 14.02 | 8.82 | 5.2 | |
| | 20 | David Coffee* | 31.2 | 14.16 | 9.16 | 5.0 | |
| | 20 | F. E. Comstock | 29.1 | 12.23 | 8.43 | 3.8 | |
| | 20 | L. N. Dimmock* | 31.2 | 12.49 | 8.99 | 3.5 | |
| | 20 | Elmwood Farm, Waterford | 30.1 | 12.20 | 8.40 | 3.8 | |
| | 20 | Great Neck Dairy | 29.4 | 11.89 | 8.29 | 3.6 | |
| | 20 | Howard's Dairy | 29.5 | 12.44 | 8.24 | 4.2 | |
| | 20 | H. C. Lamphere | 29.1 | 13.33 | 8.33 | 5.0 | |
| | 20 | Newbury's Dairy | 31.0 | 13.57 | 8.77 | 4.8 | |
| | 20 | Oakland Farm | 29.0 | 13.44 | 8.74 | 4.7 | |
| | 20 | Ocean View Farm | 30.0 | 13.95 | 9.15 | 4.8 | |
| | 20 | David Regan* | 31.7 | 11.62 | 8.82 | 2.8 | |
| | 20 | Leon St. Germain, Broad st. | 29.0 | 11.78 | 8.18 | 3.6 | |
| | 20 | W. F. Scott, Fairview Dairy | 28.0 | 11.68 | 7.88 | 3.8 | |
| | 20 | Smith's Dairy* | 29.1 | 13.66 | 8.56 | 5.1 | |
| | 20 | S. B. Wicks, Cloverleaf Dairy | 24.0 | 10.96 | 7.26 | 3.7 | |
| | | *Norwalk.* | | | | | |
| Aug. | 13 | Mrs. Ella R. Aiken, Silver Mine Dairy | 29.3 | 12.01 | 8.51 | 3.5 | |
| | 13 | C. O. Middlebrook | 28.8 | 13.11 | 8.51 | 4.6 | |
| | 13 | M. Roberts, Old Reliable Dairy | 20.6 | 9.64 | 5.84 | 3.8 | |
| | 13 | Louis Rodock* | 31.0 | 13.30 | 8.80 | 4.5 | |
| | 13 | G. J. Schailer, Comstock Hill | 29.0 | 12.76 | 8.56 | 4.2 | |
| | 13 | A. Welnitz | 26.5 | 10.76 | 7.06 | 3.7 | |
| | | *Norwich.* | | | | | |
| Aug. | 27 | Y. A. Bailey* | 30.5 | 12.29 | 8.69 | 3.6 | |
| | 27 | Humphrey Brennan* | 28.0 | 11.87 | 8.17 | 3.7 | |
| | 27 | H. F. Davis | 29.1 | 12.22 | 8.42 | 3.8 | |
| | 27 | W. S. DeWolf* | 29.9 | 13.05 | 8.85 | 4.2 | |
| | 27 | F. A. Gallup* | 29.4 | 14.45 | 8.85 | 5.6 | |
| | 27 | Chris. Hansen* | 29.0 | 13.74 | 8.44 | 5.3 | |
| | 27 | G. A. Jenks* | 32.4 | 13.88 | 9.28 | 4.6 | |
| | 27 | J. E. Kennedy | 26.2 | 10.67 | 7.37 | 3.3 | |
| | 27 | F. K. Kingsley* | 28.7 | 13.03 | 8.43 | 4.6 | |
| | 27 | John McNamara* | 29.4 | 11.62 | 8.22 | 3.4 | |
| | 27 | John Peckham* | 23.8 | 11.83 | 7.23 | 4.6 | |
| | 27 | Gilbert Rogers* | 29.6 | 11.64 | 8.04 | 3.6 | |
| | 27 | John Rogers* | 29.4 | 12.53 | 8.63 | 3.9 | |
| | 27 | Egbert Storer* | 29.6 | 11.65 | 8.35 | 3.3 | |
| | | *Plainville.* | | | | | |
| Sept. | 5 | W. W. Benstead | 32.4 | 13.56 | 9.16 | 4.4 | |
| | | *Plantsville.* | | | | | |

TABLE II.—MILK BOUGHT BY THE STATION OF MILKMEN—*Continued*

| Sampled. | | Dealer. | Specific gravity at 60° F. | Total solids. | Solids not fat. | Fat. | Pres ti |
|---|---|---|---|---|---|---|---|
| | | *Rockville.* | | % | % | % | |
| Sept. | 7 | Carl Ellis* | 29.5 | 12.34 | 8.34 | 4.0 | No |
| | 7 | C. Lanz* | 29.3 | 11.83 | 8.23 | 3.6 | " |
| | 7 | Fred Lugenburg* | 29.4 | 12.03 | 8.23 | 3.8 | " |
| | 7 | C. T. Slater | 28.5 | 14.37 | 8.67 | 5.7 | " |
| | | *South Norwalk.* | | | | | |
| Aug. | 13 | W. L. Bean, Gilt Edge Dairy | 31.2 | 13.04 | 8.84 | 4.2 | " |
| | 13 | J. H. Crosby* | 30.8 | 14.10 | 8.70 | 5.4 | " |
| | 13 | John DeVine, Strawberry Hill Dairy | 27.9 | 12.67 | 8.17 | 4.5 | " |
| | 13 | G. W. Guyer, Compo Dairy | 31.2 | 12.80 | 8.60 | 4.2 | " |
| | 13 | Chas. H. Hawxhurst | 30.1 | 12.51 | 8.31 | 4.2 | " |
| | 13 | Chas. E. Hoyt, Hillside Dairy | 28.6 | 12.52 | 8.12 | 4.4 | " |
| | 13 | David Jenks, Belden Hill Dairy | 28.4 | 9.63 | 7.83 | 1.8 | " |
| | 13 | W. D. Keller, Ridgewood Farm Dairy | 30.1 | 12.18 | 8.58 | 3.6 | " |
| | 13 | C. Ruscoe* | 31.2 | 13.36 | 8.96 | 4.4 | " |
| | 13 | F. R. Waters | 31.5 | 12.86 | 8.66 | 4.2 | " |
| | | *Southington.* | | | | | |
| Sept. | 6 | J. Delahunty | 31.0 | 12.88 | 8.68 | 4.2 | " |
| | 6 | M. Eagan* | 28.4 | 11.48 | 8.18 | 3.3 | " |
| | 6 | Hart's Clover Leaf Farm | 30.9 | 12.57 | 8.77 | 3.8 | " |
| | 6 | Maple Hill Farm | 31.5 | 14.60 | 9.20 | 5.4 | " |
| | 6 | N. C. Newell* | 30.1 | 13.14 | 8.74 | 4.4 | " |
| | | *Stamford.* | | | | | |
| Aug. | 10 | J. H. Bedell, Long Ridge Dairy | 29.5 | 11.62 | 7.92 | 3.7 | " |
| | 10 | J. H. Bedell, Long Ridge Dairy | 27.8 | 14.05 | 8.15 | 5.9 | " |
| | 10 | Chas. Button, No. 114* | 30.3 | 13.37 | 8.67 | 4.7 | " |
| | 10 | H. I. Dann, Mt. Pleasant Dairy | 27.9 | 11.84 | 7.84 | 4.0 | " |
| | 10 | H. I. Dann, Mt. Pleasant Dairy | 26.7 | 16.12 | 8.52 | 7.6 | " |
| | 10 | H. I. Dann, No. 134, Mt. Pleasant Dairy | 27.8 | 14.59 | 8.29 | 6.3 | " |
| | 10 | Patrick Larkin, No. 125* | 29.3 | 12.58 | 8.38 | 4.2 | " |
| | 10 | E. B. Marrer, Suburban Dairy | 28.8 | 11.79 | 7.99 | 3.8 | " |
| | 10 | J. McFarlan, No. 138, So. Stamford Dairy | 28.5 | 11.47 | 7.86 | 3.6 | " |
| | 10 | Rock Hill Dairy | 31.8 | 12.92 | 8.82 | 4.1 | " |
| | 10 | Darius Sarr, No. 145, Hillcrest Farm | 30.8 | 13.42 | 8.92 | 4.5 | " |
| | 10 | S. Tompkins | 26.5 | 13.74 | 8.14 | 5.6 | " |
| | 10 | W. F. Waterbury, Maplehurst Dairy | 29.3 | 12.52 | 7.92 | 4.6 | " |
| | 10 | E. L. Weed, No. 164 | 30.6 | 12.82 | 8.62 | 4.2 | " |
| | 10 | Westover Dairy, H. L. Palmer, Supt. | 30.7 | 12.90 | 8.70 | 4.2 | " |
| | 10 | Westover Dairy, No. 165 | 29.5 | 12.50 | 8.30 | 4.2 | " |
| | | *Wallingford.* | | | | | |
| Sept. | 4 | A. A. Blakeslee | 28.6 | 12.24 | 8.14 | 4.1 | " |
| | 4 | Clarence Epell* | 27.6 | 11.23 | 7.73 | 3.5 | " |
| | 4 | N. E. Fenn* | 27.5 | 11.93 | 7.83 | 4.1 | " |
| | 4 | R. Foraker | 29.8 | 12.50 | 8.60 | 3.9 | " |
| | 4 | W. H. Harrison | 27.7 | 12.46 | 7.96 | 4.5 | " |
| | 4 | John Hess* | 30.8 | 13.18 | 8.78 | 4.4 | " |
| | 4 | L. W. Hitchcock* | 30.0 | 12.17 | 8.47 | 3.7 | " |

TABLE II.—MILK BOUGHT BY THE STATION OF MILKMEN—*Concl*

| Station No. | Sampled. | Dealer. | Specific gravity at 60° F. | Total solids. | Solids not fat. | Fat. |
|---|---|---|---|---|---|---|
| | | *Wallingford.* | | % | % | % |
| 17228 | Sept. 4 | Geo. Odett* | 27.5 | 12.15 | 7.85 | 4.3 |
| 17235 | 4 | Thomas Pring* | 29.0 | 12.16 | 8.16 | 4.0 |
| 17238 | 4 | C. L. Rose & Son | 30.6 | 12.54 | 8.64 | 3.9 |
| 17224 | 4 | B. R. Tyler* | 28.5 | 12.89 | 8.19 | 4.7 |
| 17230 | 4 | E. R. Warner | 31.3 | 13.71 | 9.01 | 4.7 |
| 17233 | 4 | C. L. Williams | 29.9 | 12.23 | 8.63 | 3.6 |
| 17232 | 4 | Geo. Williams* | 29.9 | 13.29 | 8.69 | 4.6 |
| 17237 | 4 | H. S. Williams | 30.5 | 11.75 | 8.55 | 3.2 |
| 17223 | 4 | J. D. Williams | 32.3 | 13.35 | 8.85 | 4.5 |
| | | *Waterbury.* | | | | |
| 17026 | Aug. 21 | Anthony Atilas* | 29.8 | 13.37 | 8.77 | 4.6 |
| 17035 | 21 | James Bergen, No. 54 | 28.4 | 11.15 | 7.95 | 3.2 |
| 17038 | 21 | S. P. Bronson, No. 157, East Farms | 30.0 | 12.74 | 8.54 | 4.2 |
| 17024 | 21 | Buckingham Bros. | 30.3 | 13.10 | 8.60 | 4.5 |
| 17023 | 21 | F. P. Clough, No. 126 | 30.5 | 12.67 | 8.57 | 4.1 |
| 17027 | 21 | T. B. Eggleston | 26.8 | 10.83 | 7.33 | 3.5 |
| 17039 | 21 | W. I. Emmons, No. 303 | 24.7 | 9.87 | 6.67 | 3.2 |
| 17041 | 21 | G. A. Harper, No. 232, Spring Hill Farm | 31.2 | 11.93 | 8.33 | 3.6 |
| 17030 | 21 | C. Kernathan | 26.7 | 11.25 | 7.65 | 3.6 |
| 17031 | 21 | Lockwood Bros., No. 67 | 29.1 | 12.99 | 8.49 | 4.5 |
| 17029 | 21 | W. J. Munson, No. 36 | 29.9 | 12.79 | 8.59 | 4.2 |
| 17028 | 21 | E. H. Oviatt | 28.4 | 12.19 | 8.19 | 4.0 |
| 17036 | 21 | Patterson & Ives, Goshen, Milk and Cream | 29.6 | 12.69 | 8.69 | 4.0 |
| 17033 | 21 | F. C. Porter | 30.4 | 12.73 | 8.63 | 4.1 |
| 17034 | 21 | F. C. Porter | 30.4 | 12.42 | 8.52 | 3.9 |
| 7025 | 21 | H. Rasmussen | 31.4 | 13.01 | 8.91 | 4.1 |
| 7032 | 21 | C. Rasmussen, No. 9 | 28.5 | 11.84 | 8.14 | 3.7 |
| 7040 | 21 | G. S. Sprague, No. 266 | 30.1 | 13.10 | 8.70 | 4.4 |
| 7037 | 21 | W. S. Strong, East Mountain Farm | 30.9 | 13.30 | 8.90 | 4.4 |
| | | *Willimantic.* | | | | |
| 7156 | Aug. 28 | Albert Adams* | 29.1 | 13.27 | 8.57 | 4.7 |
| 7153 | 28 | G. W. Andrews* | 29.6 | 12.59 | 8.59 | 4.0 |
| 7158 | 28 | G. H. Andrews, Crystal Spring Dairy | 29.0 | 11.90 | 8.30 | 3.6 |
| 7162 | 28 | Brindamour Bros., Rock Farm | 27.5 | 11.35 | 7.85 | 3.5 |
| 7157 | 28 | S. P. Brown | 29.1 | 13.91 | 8.71 | 5.2 |
| 7159 | 28 | F. W. Edgerton | 31.4 | 12.65 | 8.75 | 3.9 |
| 7165 | 28 | J. M. Gager | 29.8 | 13.39 | 8.69 | 4.7 |
| 7161 | 28 | J. H. Griggs | 30.6 | 11.37 | 8.47 | 2.9 |
| 7166 | 28 | C. M. Holbrook* | 24.0 | 14.69 | 7.69 | 7.0 |
| 7160 | 28 | C. H. Hoxie | 29.6 | 11.92 | 8.22 | 3.7 |
| 7168 | 28 | A. C. Jacobs | 30.9 | 12.23 | 8.73 | 3.5 |
| 7167 | 28 | G. Rappelye* | 29.4 | 12.79 | 8.39 | 4.4 |
| 7169 | 28 | F. Rosebrooks* | 30.0 | 12.43 | 8.43 | 4.0 |
| 7154 | 28 | I. H. Stanton* | 31.2 | 11.76 | 8.66 | 3.1 |
| 7164 | 28 | J. H. Stearns | 31.1 | 12.39 | 8.59 | 3.8 |
| 7163 | 28 | V. D. Stearns | 31.1 | 13.18 | 8.68 | 4.5 |
| 7155 | 28 | W. H. Terry & Son, Glenview Farm | 29.1 | 12.96 | 8.56 | 4.4 |

* Statement of driver.

## UNSWEETENED CONDENSED MILK ("EVAPORATED CREAM").

*Condensed milk or evaporated milk* (commonly known as unsweetened condensed milk and erroneously as condensed cream), according to the United States Standards, is milk from which a considerable portion of water has been evaporated and should contain not less than 28 per cent. of milk solids, of which not less than 27.5 per cent. is milk fat. It differs from sweetened condensed milk (commonly labelled "condensed milk") in that it contains no added sugar.

The common adulteration of condensed milk consists in using skimmed milk instead of whole milk for its preparation. Watering of the original milk is a disadvantage to the manufacturer, as it necessitates longer evaporation, and the use of preservatives is unnecessary when the product is thoroughly sterilized and packed in hermetically sealed cans, although they might serve to keep the milk previous to evaporation or after opening the cans.

**Examination of Samples.**—Eight brands have been analyzed with the results given in Table III. Only 4 of these contained over 28 per cent. of solids, showing that they had been evaporated sufficiently to conform to the legal standard for this product. From the percentages of constituents in the milk solids, or in other words, from the analysis as calculated to the dry substance, it appears that 6 were made from whole milk, or milk with at least 27.5 per cent. of fat in the milk solids, while 2 were below standard in this respect.

## BUTTER AND BUTTER SUBSTITUTES.

Sixteen samples were tested for the dairy commissioner. Three were natural butter, 3 renovated butter, and 10 oleomargarine or butterine.

## KORNO PRODUCTS.

These products, made by Gilbert Parker & Co., Philadelphia designed especially for the use of bakers, include Korno Paste Shortening, Korno Extra Shortening, Parker's Vegetable Oil Parker's Korno Extra Milk Powder, Korno Milk Powder, and Parker's Korno Substitute.

TABLE III.—ANALYS

| | Brand. | Dealer. |
|---|---|---|
| 77 | Scranton Condensed Milk Co., New York. Gilt Edge | *Ansonia.* D. M. Welch & Son, 188 Main st. |
| 04 | Helvetia Milk Condensing Co., Highland, Ill. Highland | *Hartford.* The Model Market, 123 Ann st. |
| 30 | Van Camp Condensed Milk Co., Effingham, Ill. Top Notch | *Meriden.* M. W. Booth, E. Main st. |
| 33 | Borden's Condensed Milk Co., New York. Borden's Peerless | *New Britain.* Public Market, 373 Main st. |
| 32 | Hires Condensed Milk Co., Philadelphia, Pa. Gold | *Stamford.* C. Andresen & Co., 490 Main st. |
| 36 | Helvetia Milk Condensing Co., Highland, Ill. Pet | Empire State Tea Co., Atlantic sq. |
| 35 | St. Charles Condensing Co., St. Charles, Ill. St. Charles | W. W. Waterbury, 501 Main st. |
| 33 | St. Charles Condensing Co., St. Charles, Ill. Silver Cow | R. T. Woodbury, 107 Pacific st. |

Our attention was called to the shortening preparations by the dairy commissioner, who has found them in use by bakers in different parts of the state.

Analyses of samples collected by the station follow:

| | 16038 Korno Extra Shortening. | 16042 Korno Paste Shortening. |
|---|---|---|
| Moisture | 7.23 | 6.32 |
| Salt | 4.36 | 1.64 |
| Fat and Oil | 88.41 | 92.04 |
| Coal-tar Color | present | present |
| | 100.00 | 100.00 |
| Constants of the Fat: | | |
| Köttstorfer Number | 193.9 | 195.1 |
| Reichert-Meissl Number | 0.53 | 0.93 |
| Hübl's Iodine Number | 67.3 | 70.75 |
| Titer Test | 40.0°C | 42.0°C |
| Melting Point | 40.0°C | 46.6°C |
| Refractive Index at 50° | 1.4563 | 1.4568 |

Both products contained cotton seed oil, but the characteristic constituent appears to be corn (maize) oil stiffened with a

NSWEETENED CONDENSED MILK ("EVAPORATED CREAM").

| Station No. | Price per can, cents. | Oz. (avoir.) in can. | In the material as sold. | | | | | | In the milk solids. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Water. | Total solids. | Ash. | Protein. | Milk sugar. | Fat. | Ash. | Protein. | Milk sugar. |
| | | | % | % | % | % | % | % | % | % | % |
| 377 | 8 | 13 | 70.11 | 29.89 | 1.70 | 8.60 | 11.99 | 7.60 | 5.68 | 28.78 | 40.11 |
| 704 | 12 | 13 | 69.70 | 30.30 | 1.85 | 8.31 | 11.46 | 8.68 | 6.11 | 27.42 | 37.83 |
| 330 | 10 | 12 | 73.49 | 26.51 | 1.53 | 7.05 | 10.45 | 7.48 | 5.77 | 26.59 | 39.42 |
| 733 | 10 | 12 | 73.68 | 26.32 | 1.52 | 6.95 | 10.25 | 7.60 | 5.78 | 26.40 | 38.94 |
| 132 | 10 | 17 | 75.19 | 24.81 | 1.49 | 7.22 | 10.49 | 5.61 | 6.01 | 29.10 | 42.28 |
| 136 | 5 | 7 | 73.66 | 26.34 | 1.58 | 6.86 | 10.43 | 7.47 | 6.00 | 26.04 | 39.60 |
| 135 | 10 | 12 | 68.93 | 31.07 | 1.80 | 8.75 | 11.86 | 8.66 | 5.79 | 28.17 | 38.17 |
| 133 | 5 | 7 | 70.09 | 29.91 | 1.81 | 8.31 | 11.31 | 8.48 | 6.06 | 27.79 | 37.79 |

harder fat, such as stearin. The manufacturers state in their description of Parker's Korno Vegetable Oil: "The foundation of our successful launching of Korno Products must be given to this oil made from corn."

## LARD.

Lard, according to the United States Standards, "is the rendered fresh fat from hogs in good health at the time of slaughter, is clean, free from rancidity, and contains, necessarily incorporated in the process of rendering, not more than one per cent. of substances other than fatty acids and fat." Compound lard is a mixture of cotton seed oil with enough beef stearin to give it the requisite degree of solidity and a small amount of real lard. Lard stearin (the residue left after expressing lard oil), cotton seed stearin (obtained in the manufacture of "Winter" cotton seed oil,) or, rarely, paraffine may be used in place of beef stearin.

Although compound lard is made according to different formulas to meet the requirements of different markets, the product

TABLE IV.—ADULTERATED LARD.

| Station No. | Brand. | Dealer. | Price per pound, cents. |
|---|---|---|---|
| | | *Bridgeport.* | |
| 14886 | Sold in bulk | Centennial Tea Co., 1688 Main st. | 10 |
| 14885 | " " " | H. Isenberg & Co., 44 Cannon st. | 9 |
| | | *Hartford.* | |
| 15181 | " " " | Clinton Market, S. Prospect and Sheldon sts. | 10 |
| 14755 | " " " | Dow's Grocery, 2 Church st. | 10 |
| 14758 | " " " | T. S. Mather, 236 Albany ave. | 10 |
| 14701 | " " " | The Hartford Market Co., Main & Mulberry sts. | 8 |
| 14757 | " " " | Wm. Walters, 1219 Main st. | 10 |
| | | *Middletown.* | |
| 15081 | " " " | F. P. Brennan, 220 Main st. | 10 |
| | | *New Britain.* | |
| 14719 | " " " | J. E. Murphy, 500 Main st. | 10 |
| | | *New Haven.* | |
| 15165 | " " " | Enterprise Specialty Co., 417 State st. | 13 |
| 15164 | " " " | A. D. Hoppman, 103 Dixwell ave. | 8 |
| | | *New London.* | |
| 14993 | " " " | Geo. H. Meschendorf, 55 Truman st. | 10 |
| 14992 | " " " | N. Y. Cash Grocery, 155 Bank st. | 10 |
| | | *Norwalk.* | |
| 14954 | " " " | Union Grocery Co., 10 Main st. | 9 |
| | | *Norwich.* | |
| 15021 | " " " | The Mohican Co., 260 Main st. | 8 |
| | | *Putnam.* | |
| 15048 | " " " | J. E. Sullivan, 127 Main st. | 10 |
| | | *South Norwalk.* | |
| 14921 | " " " | United Grocery Co., N. Main st. | 10 |
| | | *Southington.* | |
| 15222 | " " " | C. P. Owen, Main st. | 8 |
| | | *Stamford.* | |
| 14929 | " " " | O. S. Brown, Atlantic Square | 9 |
| 14931 | " " " | R. T. Woodbury, 107 Pacific st. | 9 |
| | | *Torrington.* | |
| 15292 | " " " | N. Y. Butter House, 16 Water st. | 8 |
| | | *Waterbury.* | |
| 15274 | " " " | J. Baltrush, 875 Bank st. | 10 |
| 14841 | " " " | Boston Butter House, 157 S. Main st. | 10 |
| 14836 | " " " | P. S. Corden, Wolcott and E. Main sts. | 10 |
| 14843 | " " " | P. T. Gervais, 192 S. Main st. | 10 |
| 15272 | " " " | Joseph Kudirka, 881 Bank st. | 8 |
| 14835 | " " " | J. P. McCarthy, 671 E. Main st. | 10 |
| 15275 | " " " | Prisavage Bros., 798 Bank st. | 10 |
| 15268 | " " " | Santoro Bros., 34 Abbott ave. | 10 |
| 14842 | " " " | John Tato, 360 W. Main st | 10 |
| 15270 | " " " | The Spencer & Pierpont Co., 352 E. Main st. | 10 |
| 15271 | " " " | Waterbury Lithuanian Market, 905 Bank st. | 10 |

*almost invariably contains more cotton seed oil than all the other* ingredients taken together. Real lard is a minor constituent.

**Examination of Samples.**—During the year, 115 samples, bought for lard by the station agent from grocers and butchers, have been examined. Of these 34 were compound lard and therefore were classed as adulterated (Table IV). Of 20 samples, later submitted by the dairy commissioner, 8 were pure lard, 9 were compound lard sold for pure lard, and 3 were marked "compound."

The sale of compound lard as such is legitimate. The sale of compound lard when "lard" is called for is fraudulent.

TABLE V.—ADULTERATED OLIVE OIL.

| Station No. | Brand. | Dealer. | Price per bottle, cents. | Ounces of oil in bottle. |
|---|---|---|---|---|
| | *Adulterated with Cotton Seed Oil.* | *Bridgeport.* | | |
| 15234 | Sold in druggist's vial. | J. A. Leverty, 608 Park ave. | 20 | 4 |
| 14915 | " " " | McNamara's Pharmacy, 1892 Main st. | 15 | 4 |
| | | *Bristol.* | | |
| 15100 | " " " | Wm. J. Madden, Prospect st. | 15 | 4 |
| | | *Danielson.* | | |
| 15046 | " " " | A. L. Reeves & Co., 183 Main st. | 20 | 4 |
| | | *Hartford.* | | |
| 15185 | " " " | The Modern Pharmacy, 299 Park st. | 20 | 4 |
| | | *New Haven.* | | |
| 15170 | " " " | Hull's Corner Drug Store, State and Chapel sts. | 20 | 4 |
| | | *New London.* | | |
| 14996 | " " " | Nichols & Harris, 119 State st. | 20 | 4 |
| 14998 | " " " | C. M. Rogers, 9 Main st. | 20 | 4 |
| | | *Waterbury.* | | |
| 14846 | " " " | J. P. Fitzpatrick, Wall and E. Main sts. | 20 | 4 |
| 14848 | " " " | E. M. Roberts, 463 W. Main st. | 20 | 4 |
| | *Adulterated with Sesame Oil.* | *New London.* | | |
| 14999 | Sold in druggist's vial. | Taylor's Pharmacy, State and Main sts. | 30 | 4 |

## OLIVE OIL.

Of 102 samples, purchased by the station, 10 were adulterated with cotton seed oil, 1 with sesame oil, and 11, although consisting of cotton seed oil, were labelled salad oil and are therefore technically compounds. All the adulterated samples were purchased of druggists (see Table V).

Eight samples were collected by the dairy commissioner, of which 3 were not found adulterated, 3 were adulterated, and 2 were compounds.

## SAUSAGE.

Tests for preservatives were made in 88 samples of pork sausage collected by the station. Forty of these samples contained boric acid (or borax) and consequently were pronounced adulterated (see Table VI).

Of the remaining samples 36 contained sulphurous acid. This acid, in the form of the free acid or as bisulphite of soda, has been extensively employed for bleaching molasses, syrups, and as a preservative for sauternes and other wines. Apples, apricots, and other fruits are commonly subjected to burning sulphur during the drying process and as a consequence absorb sulphurous acid, which serves both to improve the appearance of the dried product and to prevent the growth of moulds and the depredations of insects.

As these practices have been sanctioned by the trade and to some extent by national and state rulings, it was deemed expedient to reserve judgment on the use of sulphurous acid preservatives in meat products until the matter could receive further consideration.

It should be stated, however, that the use of sulphurous acid in meat products is more objectionable than in syrups and fruit products since it acts not merely as a preservative but also as a deodorizer, thus concealing incipient putrefaction. By its use meat which is discolored and swarming with bacteria may be made to appear normal in color and odor and the consumer is deceived as to its wholesomeness. It is not improbable that hereafter the use of this preservative will be prohibited by special ruling—in fact under a strict interpretation of the Connecticut food law its use is now illegal.

## Table VI.—Pork Sausage Containing Boric Acid.

| Station No. | Dealer. | Price per pound, cents. |
|---|---|---|
| | *Bridgeport.* | |
| 15359 | R. W. Parrott, 388 E. Main st. | 12 |
| 15363 | H. Isenberg & Co., 48 Cannon st. | 12 |
| 15362 | D. E. McNamara, 1894 Main st. | 10 |
| 15361 | J. M. O'Connell, 1284 Main st. | 11 |
| 15360 | J. H. Whitcomb, 1193 E. Main st. | 11 |
| | *Danbury.* | |
| 15418 | Barrett's Market, 151 Main st. | 14 |
| 15420 | City Market, 303 Main st. | 13 |
| 15421 | Danbury Market, 59 White st. | 13 |
| 15417 | Richard Meaney, 93 Town Hill ave. | 14 |
| | *Hartford.* | |
| 15480 | Dow's Market, 2 Church st. | 12 |
| | *Meriden.* | |
| 15447 | Ansell's Market, 282 West Main st. | 12 |
| 15449 | Booth's Market, E. Main st. | 12 |
| 15450 | Adam Orr, 8 Colony st. | 10 |
| | *Middletown.* | |
| 15562 | F. P. Brennen, 208 Main st. | 12 |
| 15563 | The Co-operative Store, 145 College st. | 12 |
| | *New Britain.* | |
| 15459 | Trewhella's Market, 36 Church st. | 12 |
| | *New Haven.* | |
| 15335 | Booth Meat Co., 51 Dixwell ave. | 10 |
| 15350 | Booth Meat Co., 7 Grand ave. | 10 |
| 15313 | Geo. Jacobs & Bro., 26 Congress ave. | 10 |
| 15314 | E. Schoenberger & Son, 84 George st. | 9 |
| 15312 | E. Schoenberger & Son, 772 State st. | 10 |
| | *New London.* | |
| 15507 | G. M. Chapin, Jr., 59 Washington st. | 12 |
| 15503 | G. R. Gray, 91 Broad st. | 12 |
| 15508 | H. Meadnis, 80 Bank st. | 12 |
| 15509 | Union Market, 55 Truman st. | 12 |
| 15504 | H. A. Whiting, 110 State st. | 12 |
| | *Norwich.* | |
| 15524 | Henry Norman, 36 Franklin st. | 12 |
| 15529 | Sweet's Market, 86 Franklin st. | 10 |
| 15530 | The Mohican Co., 264 Main st. | 12 |
| 15527 | E. Tracy, 127 W. Main st. | 13 |
| | *Stamford.* | |
| 15411 | E. P. Jordan, 161 Canal st. | 12 |
| 15412 | Union Market, 79 Railroad ave. | 12 |
| 15413 | Washington Market, 65 Pacific st. | 12 |
| 15410 | J. M. Wassing, 572 Atlantic st. | 12 |
| | *Waterbury.* | |
| 15577 | Gallagher Bros., 375 E. Main st. | 12 |
| 15578 | The Waterbury Market Co., 156–160 S. Main st. | 10 |
| | *Willimantic.* | |
| 15545 | Central Market, 27 North st. | 12 |
| 15544 | Mullen & St. Onge, Jackson and Spruce sts. | 10 |

Numerous samples of pork sausage, bologna sausage, and frankfort sausage, submitted by the dairy commissioner, have been tested for boric acid with the following results.

| | Number of samples free from boric acid. | Number of samples containing boric acid. | Total. |
|---|---|---|---|
| Pork Sausage | 47 | 5 | 52 |
| Bologna Sausage | 27 | 17 | 44 |
| Frankfort Sausage | 39 | 17 | 56 |
| Total | 113 | 39 | 152 |

## HAMBURG STEAK.

Twenty-one samples were tested for preservatives. No boric acid was detected in any of the samples but 12 contained sulphurous acid, doubtless added as bisulphite of soda. All the samples thus preserved were ready chopped.

Since butchers use the trimmings from beef for Hamburg steak, depending on bisulphite of soda to prevent tainting or else to deodorize meat already tainted and give it the bright red color of fresh meat, it is advisable for consumers either to chop the meat for themselves or else have this done by the butcher in their presence.

Further remarks on the use of sulphurous acid in food products are given under sausage, p. 126.

## OYSTERS.

Nineteen samples of opened oysters were examined during the year for preservatives. One sample, No. 15473, purchased at Franklain Market, 516 Main St., Hartford, contained boric acid.

Of 75 samples examined in 1897 no less than 13 contained borax (or boric acid) in quantities equivalent to from 0.7 to 5.7 parts by weight of borax in 1000 of the oysters.

## CODFISH.

Sixteen brands, collected by the dairy commissioner, were examined for preservatives and all but 2 were found to contain boric acid.

## SUGAR.

A sample of granulated sugar, examined for the dairy commissioner, was found to be nearly chemically pure. Contrary to the common belief, adulterated sugar is not, at the present time, an article of commerce.

## MOLASSES.

The dairy commissioner submitted for examination 303 samples, of which 3 contained glucose syrup.

## MAPLE SYRUP.

Maple syrup is prepared by the evaporation of maple sap to the proper consistency or by dissolving maple sugar in water. The chief saccharine constituent is sucrose, the same sugar as is contained in the sugar cane and the sugar beet, but the value of the product depends largely on certain flavoring principles peculiar to maple sap.

Formerly maple syrup was adulterated with or substituted by glucose syrup or brown sugar syrup, the maple flavoring being imitated by the addition of oil of hickory bark or extract of corn cob, but for some years the chief adulteration has consisted in the addition of refined sugar syrup, the real maple syrup present being depended on to flavor the whole. Since pure maple syrup consists largely of ordinary sugar (sucrose), the direct detection of added sugar syrup is obviously impossible, but its presence is easily shown by the determination of minor constituents peculiar to maple products. Maple syrup contains at least 0.45 per cent of ash and a certain percentage of malic acid, whereas refined sugar contains but a trace of either. Valuable information is gained by the addition of basic lead acetate, which forms with true maple syrup a copious precipitate but none whatever with refined sugar syrup.

**Examination of Samples.**—Thirty-nine samples collected by the station, representing 37 brands, have been examined. Only 3 of these were pure maple syrups (see Table VII), the remainder consisting of mixtures of maple and cane syrups. Nineteen of these mixtures were labelled as such and are therefore classed as compounds (Table VIII), but 17 were labelled maple

TABLE VII.—MAPLE

| Station No. | Brand. | Dealer. |
|---|---|---|
| 15988 | Welch Bro's Maple Co., Burlington, Vermont, Vermont's Finest Quality | *Hartford.* Boston Branch Grocery, 745 Main st. |
| 15989 | Newton, Robertson & Co., Hartford, Conn. (Canned at Burlington, Vermont) | Newton, Robertson & Co., 338 Asylum st. |
| 16037 | Huntington Maple Syrup and Sugar Co., Brattleboro, Vt., E. Providence, R. I. Puritan Brand Pure Vermont | *Norwich.* R. T. Smith, 47 Shetucket st. |

syrup and were pronounced adulterated (Table IX). None of the adulterated or compound syrups contained over 50 per cent of pure maple syrup and many of them contained scarcely an appreciable amount.

### METHODS OF ANALYSIS.

*Total Solids.* Dry 2 grams with about 10 grams of sand in a round flat bottom dish 8 cm. in diameter on a water bath with constant stirring. Complete the drying to constant weight at the temperature of boiling water.

*Sucrose by Clerget's Formula.*—Dissolve 26.048 grams in water, add lead subacetate solution until no further precipitate forms, make up to 100 cc., filter through a dry paper and polarize before and after inversion. Calculate the sucrose by Clerget's formula (U. S. Dept. Agr., Bureau Chem. Bull. 65, p. 48).

*Hortvet Number.*—See Hortvet: Jour. Amer. Chem. Soc. 1904, 26, 1532.

*Lead Number**.—Weigh 25 grams of the material (or 26.048 grams if it is desired to determine sugars polariscopically on the same portion) into a 100 cc. flask. Add 25 cc. of standard lead subacetate solution, fill to the mark, shake, allow to stand at least one hour, and filter. From the clear filtrate pipette off 10 cc., dilute to 50 cc., add a moderate excess of sulphuric acid and 100 cc. of 95 per cent alcohol. Let stand over night, filter on a Gooch crucible, wash with 95 per cent. alcohol, dry at a moderate heat, ignite at low redness for three minutes taking care to avoid the reducing cone of the flame, and weigh. Calculate the amount of lead in the precipitate (factor 0.6829), subtract this from the amount in 2.5 cc. of the standard solution, and divide the remainder by 2.5, thus obtaining the "*Lead Number.*"

* See WINTON and KREIDER: Jour. Amer. Chem. Soc. 1906, 28, 1204.

SYRUP NOT FOUND ADULTERATED.

| Station No. | Price per bottle, cents. | Capacity of bottle, fluid ounces. | Total solids. | Sucrose by Clerget's formula. | Hortvet number.* | Lead number. | Total ash. |
|---|---|---|---|---|---|---|---|
| | | | % | % | | | % |
| 15988 | 25 | 16 | 66.98 | 62.4 | 1.00 | 2.03 | 0.75 |
| 15989 | 30 | 16 | 67.29 | 61.6 | 0.69 | 1.61 | 0.60 |
| 16037 | 38 | 25 | 66.40 | 59.5 | 1.24 | 1.89 | 0.54 |

* cc. of lead subacetate precipitate from 5 grams of the material.

The standard lead subacetate is prepared as follows: Boil for half an hour 430 grams of normal lead acetate and 130 grams of litharge with 1000 cc. of water. Cool the mixture, allow to settle, and dilute the supernatant liquid to 1.25 specific gravity. To a measured amount of this solution add four volumes of water and filter if not perfectly clear.

The standard of the solution is determined in 25 cc. by the lead sulphate method as above described. On standing, it deposits a slight precipitate, but our tests show that the strength is not appreciably affected in a year.

Given sufficient Gooch crucibles, about 24 determinations of lead number can be made in eight hours distributed through two days.

*Total Ash.*—Burn 10 grams in a platinum dish at a heat below redness.

It is worthy of mention that every result obtained by these methods, excepting those for total solids and sucrose, furnishes positive evidence of foreign admixture (see Tables VIII and IX). Even the results for solids and sucrose are valuable, as the difference between the two is usually greater in the case of pure syrup.

## MAPLE SUGAR.

A single sample (No. 16012), purchased of O. H. Cone, 262 Main St., Middletown, was adulterated with ordinary sugar. It contained but 0.19 per cent. of ash, whereas standard maple sugar should contain at least 0.65 per cent.

*TABLE VIII.—COMPOUND**

| Station No. | Brand. | Dealer. |
|---|---|---|
| 15957 | Huntington Maple Syrup and Sugar Co., Huntington, Vt., Providence, R. I. Gold Leaf Brand Pure Vermont | *Bridgeport.* H. Isenberg, 50 Cannon st. |
| 15944 | W. J. Lamb Company, West Somerville, Mass. | Osborne Bros., 629 Noble ave. |
| 15942 | *Huntington Maple Syrup and Sugar* Co., Huntington, Vt., Providence, R. I. Gold Leaf Brand Pure Vermont | The Great Atlantic & Pacific Tea Co., 707 E. Main st. |
| 15943 | Hudson Packing Co., New York. Table Syrup | The Village Store Co., 746 E. Main st. |
| *15945 | W. J. Lamb Co., West Somerville, *Mass. Green Mountain* | *E. E. Wheeler, 1135 Main st.* |
| 16004 | Austin, Nichols & Co., New York. Green Mountain | *Danbury.* D. W. Ehle, 3 West st. |
| 16005 | Hudson Packing Co., New York | M. J. Shanley, 147 Main st. |
| 16018 | Hartford Preserving Works, Hartford, Conn. Liberty Brand Vermont | *Hartford.* S. Bachrach, 22 Park st. |
| 15990 | Ransom N. Fitzgerald, Hartford, Conn. Mayflower | Brown, Thompson & Co., Main st. |
| 15947 | S. S. Adams, New Haven, Conn. Vermont | *New Haven.* S. S. Adams, 406 State st. |
| 15930 | D. M. Welch & Son, New Haven, Conn. Pure Vermont | D. M. Welch, 8 Grand ave. |
| 15962 | Clifton Packing Co's. Superior Vermont | *Norwalk.* N. Y. Grocery Co., 35 Main st. |
| 15961 | Hallett Table Water Co., Bridgeport, Conn. Nonquit | Union Grocery Co., 10 Main st. |
| 15965 | Wm. A. Leggett & Co., New York. Liberty Brand Vermont | *South Norwalk.* Gustave Friedrick, 13 Railroad ave. |
| 15964 | Leslie, Dunham & Co., New York. Green Mountain Brand Vermont | N. Y. Grocery Co., 118 E. Washington st. |
| 15963 | Rigney & Co., Rutland, Vt., Brooklyn, N. Y. Park Brand | United Grocery Co., 20 N. Main st. |
| 15966 | Jas. G. Powers & Co., New York. Red Shield | Edwin Wilcox, 70 E. Washington st. |
| 15994 | Vermont Maple Syrup Co., Stoweton, Vermont. Strictly Pure Vermont | *Stamford.* E. P. Jordon, 83 Manhattan st. |
| 15995 | Austin, Nichols & Co., New York. Green Mountain | R. T. Woodbury, 107 Pacific st. |

MAPLE SYRUP.

| Station No. | Price per bottle, cents. | Capacity of bottle, fluid ounces. | Total solids. | Hortvet number.* | Lead number. | Total ash. |
|---|---|---|---|---|---|---|
| | | | % | | | % |
| 15957 | 25 | 25 | 66.03 | 0.15 | 0.57 | 0.12 |
| 15944 | 32 | 25 | 65.52 | 0.36 | 0.79 | 0.24 |
| 15942 | 25 | 25 | 66.07 | 0.25 | 0.39 | 0.75 |
| 15943 | 20 | 21 | 66.49 | 0.07 | 0.08 | 0.02 |
| 15945 | 22 | 25 | 65.81 | 0.22 | 0.87 | 0.23 |
| 16004 | 20 | 17 | 65.65 | 0.07 | 0.10 | 0.04 |
| 16005 | 22 | 25 | 65.57 | 0.15 | 0.12 | 0.04 |
| 16018 | 10 | 7 | 66.82 | 0.15 | 0.53 | 0.11 |
| 15990 | 15 | 12 | 66.43 | 0.15 | 0.11 | 0.08 |
| 15947 | 20 | 25 | 68.00 | 0.07 | 0.51 | 0.07 |
| 15930 | 20 | 25 | 67.93 | 0.07 | 0.42 | 0.02 |
| 15962 | 10 | 8 | 66.53 | 0.17 | 0.83 | 0.16 |
| 15961 | 15 | 12 | 63.18 | 0.07 | 0.10 | 0.02 |
| 15965 | 15 | 14 | 67.07 | 0.15 | 0.05 | 0.04 |
| 15964 | 15 | 14 | 64.33 | 0.15 | 0.62 | 0.12 |
| 15963 | 10 | 8 | 66.07 | 0.07 | 0.08 | 0.03 |
| 15966 | 25 | 25 | 66.78 | 0.15 | 0.08 | 0.09 |
| 15994 | 25 | 25 | 65.93 | 0.07 | 0.08 | 0.01 |
| 15995 | 24 | 17 | 64.96 | 0.07 | 0.24 | 0.12 |

TABLE IX.—MAPLE SYRUP

| Station No. | Brand. | Dealer. |
|---|---|---|
| 15992 | New England Maple Syrup Co., Fairfax, St. Johnsburg, Vermont; Boston. Golden Free Brand Vermont | *Hartford.* H. R. Nickse & Co., 1111 Main st. |
| 15993 | Ayer Preserving Co., Ayer, Mass. Whitcher's Vermont | B. Shechtman, 40 Albany ave. |
| 15991 | Rigney & Co., Rutland, Vt.; Brooklyn, N. Y. Colonial Brand Pure Vermont | Wise, Smith & Co., Main st. |
| 15970 | Simpson Spring Co., So. Easton, Mass. Gold Label Brand | *Meriden.* Henry Behrens, 74 E. Main st. |
| 15971 | Vermont Maple Syrup Co., Woodstock, Vermont. Pure Vermont | H. C. Bibeau, 17 Colony st. |
| 16013 | Miner, Read & Garrette, New Haven, Conn. Home Brand Warranted Strictly Pure Vermont | *Middletown.* O. Thompson & Co., 592 Main st. |
| 15982 | The E. S. Kibbe Co., Hartford, Conn. Helmet Brand Pure Vermont | *New Britain.* Public Market, 373 Main st. |
| 15929 | J. D. Dewell & Co., New Haven, Conn. Kite Brand | *New Haven.* R. F. Copeland, 1208 State st. |
| 15948 | Moosehead Packing Co. Moosehead Brand | Geo. Jacobs, 22 Congress ave. |
| 16019 | F. J. Markle. Gold Medal Vermont | F. J. Markle, 105 Broadway |
| 15931 | Mansfield, Witham & Co., Lowell, Mass. Spindle City Brand | The Carlson Tea & Butter Co., 488 State st. |
| 15946 | Henry F. Wieler, New Haven, Conn. Montpelier Brand Pure Vermont | The Enterprise Specialty Co., 417 State st. |
| 15932 | Royal Mfg. Co. Purity Brand Vermont | A. H. Waterbury, 250 Grand ave. |
| 16036 | C. M. Tice & Co., Orleans County, Vermont; Boston, Mass. Sugar Notch Pure Vermont | *Norwich.* S. A. Bailey, 363 Main st. |
| 16035 | Brownell & Field Co., Providence, R. I. | J. G. Potter, 410 Main st. |
| 15967 | Chas. E. Seymour, So. Norwalk, Conn. Pure Vermont | *South Norwalk.* Chas. E. Seymour, 33 W. Washington st. |
| 16006 | Ransom N. Fitzgerald, Hartford, Conn. Mayflower Brand Pure Vermont | *Waterbury.* J. P. McCarthy, 671 E. Main st |

ADULTERATED WITH REFINED CANE SUGAR.

| Station No. | Price per bottle, *cents.* | Capacity of bottle, fluid ounces. | Total solids. | Sucrose by Clerget's *Formula.* | Hortvet number.* | Lead number. | Total ash. |
|---|---|---|---|---|---|---|---|
| | | | % | % | | | % |
| 15992 | 15 | 12 | 63.18 | 63.5 | 0.07 | 0.49 | 0.03 |
| 15993 | 10 | 7 | 64.76 | 63.8 | 0.00 | 0.37 | 0.03 |
| 15991 | 23 | 14 | 63.64 | 58.7 | 0.15 | 0.43 | 0.17 |
| 15970 | 15 | 12 | 66.58 | 65.2 | 0.11 | 0.19 | 0.19 |
| 15971 | 25 | 25 | 69.49 | 68.4 | 0.11 | 0.43 | 0.07 |
| 16013 | 25 | 25 | 68.03 | 61.7 | 0.11 | 0.10 | 0.07 |
| 15982 | 22 | 25 | 64.53 | 61.9 | 0.15 | 0.17 | 0.17 |
| 15929 | 20 | 25 | 66.40 | 65.4 | 0.15 | 0.66 | 0.14 |
| 15948 | 20 | 25 | 67.61 | 67.8 | 0.07 | 0.52 | 0.04 |
| 16019 | 10 | -- | 68.25 | 68.1 | 0.07 | ---- | 0.02 |
| 15931 | 25 | 25 | 66.55 | 64.1 | 0.15 | 0.37 | 0.14 |
| 15946 | 15 | 12 | 66.97 | 66.0 | 0.19 | 0.67 | 0.14 |
| 15932 | 19 | 25 | 66.90 | 65.4 | 0.15 | 0.48 | 0.16 |
| 16036 | 25 | 25 | 66.19 | 65.3 | 0.11 | 0.13 | 0.07 |
| 16035 | 25 | 25 | 65.33 | 60.0 | 0.12 | 0.92 | 0.12 |
| 15967 | 25 | 25 | 68.62 | 67.6 | 0.07 | 0.02 | 0.04 |
| 16006 | 10 | 8 | 66.13 | 65.2 | 0.11 | 0.66 | 0.08 |

* cc. of lead subacetate precipitate from 5 grams of the material.

## CHOCOLATE-COATED CONFECTIONERY.

Examinations were made of 64 samples of chocolate creams, molasses chips, and similar candies with chocolate coating, chiefly to ascertain whether cocoa butter had been replaced by paraffine. In no case was paraffine detected.

The fat extracted from the coating of most of the samples had the characters of cocoa butter; in several cases, however, unidentified foreign fats were present.

The coating of 50 samples contained corn (maize) starch and of a few of the samples foreign coloring matter.

The percentages of coating in the candies and of fat in the coating, and the constituents of the fat varied within the following limits:

| | | |
|---|---|---|
| Per cent of coating in the candy | 9.1 | 48.2 |
| Per cent of fat in the coating | 26.8 | 53.9 |
| Constants of the fat: | | |
| Köttstorfer Number | 183.2 | 208.7 |
| Hübl's Iodine Number | 27.6 | 54.4 |
| Refractive Index at 40°C | 1.4555 | 1.4591 |

## COFFEE AND COFFEE SUBSTITUTES.

Forty-two samples were collected by the station, of which 5 were adulterated and 3 were compounds.

*Adulterated Coffee* (Table X).—Three of the adulterated samples were obtained from branches of the Atlantic & Pacific Tea Co., located in different cities. All of these contained chicory, pellets containing pea hulls, and imitation coffee made from a wheat product and other materials. Another sample (No. 14973), of evidently the same mixture, was purchased from a branch of the same house in a bag marked "Granulated 8 O'clock Breakfast Compound." It appears that these bags were kept on hand but were not used in three cases out of the four under our observation and the purchaser was not informed orally of the nature of the article.

One of the adulterated samples (No. 14702) contained chicory, peas, and wheat or rye. The peas in the samples were roasted and coarsely ground, while the kernels of wheat or rye were roasted almost beyond recognition and were partly whole and partly broken.

Sample No. 15276, labelled "Daylight Mocha and Java Blend Coffee," contained chicory.

*Compounds.*—In additon to the sample mentioned above (No. 14973), 2 others were purchased.

No. 15061 "Oro Compound Java and Mocha Coffee," Seyms & Co., Hartford, contained peas and chicory.

No. 15017 "Digesto Coffee, Digesto Coffee Co., New York, contains no caffein or tannin." The product contained nothing foreign to the coffee bean, but we have made no analysis to determine whether or not, as claimed by the manufacturers, caffein and tannin have been removed.

A sample of coffee substitute was submitted by Mr. J. V. Rattlesdorfer, Superintendent of Charities, New Haven, who wished to learn the constituents and their proportion. Examination showed that the sample contained about 25 per cent of chicory and 75 per cent of a mixture of roasted peas and roasted rye.

TABLE X.—ADULTERATED GROUND COFFEE.

| | Brand. | Dealer. | Price per pound, cents. | Adulterants. |
|---|---|---|---|---|
| | | *Bridgeport.* | | |
| [illegible] | Sold in bulk | Atlantic and Pacific Tea Co., 957 Main st. | 25 | Chicory, pea-hull pell imitation coffee.* |
| | | *Hartford.* | | |
| [illegible] | Sold in bulk | J. H. McGuire, 1019 Main st. | 25 | Chicory, peas, cereal. |
| [illegible] | Sold in bulk | The Great Atlantic and Pacific Tea Co., 979 Main st. | 25 | Chicory, pea-hull pell imitation coffee. |
| | | *Waterbury.* | | |
| [illegible] | Daylight Mocha and Java Blend Coffee | Meat Market, 855 Bank st. | 25 | Chicory. |
| [illegible] | Sold in bulk | The Great Atlantic and Pacific Tea Co., 29 E. Main st. | 25 | Chicory, pea-hull pell imitation coffee. |

wn lumps made from wheat middlings to resemble coarsely crushed roasted coi

## SPICES.

Probably no class of products has been so commonly and grossly adulterated as ground spices. Examination of numerous samples at this station during the few years following 1896, when the pure food law went into effect, showed that from one-quarter to one-third of the spice sold in Connecticnt was adulterated. Since the annual retail cost of the spices sold in the state during these years, according to a conservative estimate, was about $200,000, fully $50,000 of this amount must have been expended for fraudulent mixtures.

One of the commonest adulterants is ground cocoanut shells, of which, so it is stated, several hundred tons have been annually prepared for mixing with spices in a single American city. The shells, without further treatment, resemble closely ground allspice and are a common admixture of this spice. A clove adulterant is prepared by roasting the cocoanut shell powder sufficiently to give it the desired color, while for use in pepper it is reduced to a black powder by charring. In the latter case a gray color is often secured by the addition of a light colored material, such as flour or olive stones, and the pungency reënforced by a small amount of cayenne.

Wheat flour, middlings, and bran, ground biscuit, white corn (maize) meal and cornstarch, rice flour and bran, buckwheat flour and middlings, bean meal, pea meal, cassava (tapioca) starch, ground olive stones, sawdust, and sulphate of lime (plaster or gypsum) are common light-colored adulterants. These are of a suitable color for white and black pepper but for cayenne pepper are often colored with red coal-tar dyes and for mustard are commonly used in conjunction with turmeric or some other yellow dye stuff.

Other make-weights are buckwheat hulls (for black pepper), ground screenings, linseed meal, rice bran, and mustard hulls.

White pepper and black pepper are products of the same plant, the berry in the former case being deprived of its outer coating. The so-called pepper shells containing more or less adhering dirt, obtained as a by-product in the preparation of white pepper, are extensively used as an adulterant for black pepper. Clove stems are often ground with cloves to the detriment of the latter, since they contain only about one-quarter as much oil of cloves which is the valuable flavoring constituent. Ground clove stems are also frequently substituted for ground

Exhausted cloves, a by-product in the manufacture of oil of cloves, are also utilized. Mace is sometimes mixed with Macassar mace or with Bombay mace, the former being inferior and the latter worthless.

Excessively dirty spices containing percentages of ash and sand above that prescribed by the standards are also classed as adulterated.

**Examination of Samples.**—The following tabular statement shows the number of samples collected by the station not found adulterated, found adulterated or below standard, and marked compound, together with a list of adulterants detected. Further details of the adulterated samples are given in Table XI..

The samples of black pepper with an excess of ash and sand were probably adulterated with pepper shells. In addition to adulterants reported in previous years, two new ones were detected, namely, coffee hulls (in black pepper) and cassava starch (in mustard and white pepper). Attention has been called by Street, of the New Jersey station, to the use of coffee hulls as an adulterant of wheat bran. Cassava starch is now imported in considerable amount from the East and is said to be cheaper than corn starch.

Of 24 samples sampled by the dairy commissioner, 9 were found adulterated or below standard and 1 was marked compound.

SUMMARY OF EXAMINATIONS OF SPICES.

| | Number of samples not found adulterated. | Number of samples adulterated or below standard. | Number of samples marked compound. | Foreign matter. |
|---|---|---|---|---|
| Allspice | 42 | 1 | ---- | Cocoanut shells. |
| Black Pepper | 38 | 10 | 1 | Nut shells, olive stones, cayenne, wheat product, coffee hulls. |
| Cayenne | 39 | 2 | ---- | Maize product, coal-tar dye. |
| Mustard | 58 | 10 | 1 | Wheat product, maize product, cassava starch, turmeric. |
| White Pepper | 27 | 4 | ---- | Wheat product, maize product, cassava starch. |

TABLE XI.—SPICES, ADULTERATED OR BELOW STANDARD.

| Station No. | Brand. | Dealer. | Price per ¼ pound, cents. | Ash. | Sand. | Adulterants. |
|---|---|---|---|---|---|---|
| | | | | % | % | |
| | *Allspice.* | *New Haven.* | | | | |
| 15146 | Sold in bulk | M. Mendelsohn, 470 Columbus ave. | 7 | ...... | ...... | Cocoanut shells. |
| | *Black Pepper.* | *Ansonia.* | | | | |
| 15240 | Sold in bulk | P. W. Fogarty, 13 High st. | 10 | ...... | ...... | Nut shells, wheat product, cayenne, other foreign material. |
| | | *Danielson.* | | | | |
| 15043 | Sold in bulk | A. Thetrault, 218 Main st. | 10 | ...... | ...... | Olive stones, cayenne. |
| | | *Meriden.* | | | | |
| 14814 | Sold in bulk | F. E. Yale, Broad st. | 9 | ...... | ...... | Starchy material. |
| | | *New Haven.* | | | | |
| 15153 | Sold in bulk | W. R. Bailey, 413 Congress ave. | 10 | 10.67 | 3.50 | Excess of ash and sand. |
| 15176 | " " " | C. Kipp, 290 Dixwell av. | 8 | 10.95 | 3.43 | Excess of ash and sand. |
| 15152 | " " " | M. Mendelsohn, 470 Congress ave. | 7 | ...... | ...... | Olive stones. |
| 14884 | " " " | F. A. Voelker, 38 Foster st. | 8 | 10.73 | 3.70 | Excess of ash and sand. |
| | | *Southington.* | | | | |
| 15224 | Sold in bulk | C. D. Owen, Main st. | 10 | 10.56 | 4.13 | Excess of ash and sand. |
| | | *Torrington.* | | | | |
| 15300 | Sold in bulk | Torrington Cash Grocery, 28 Water st. | 7 | ...... | ...... | Olive stones, coffee hulls, cayenne. |

TABLE XI.—SPICES, ADULTERATED OR BELOW STANDARD—*Continued.*

| Station No. | Brand. | Dealer. | Price per ¼ pound, cents. | Ash. | Sand. | Adulterants. |
|---|---|---|---|---|---|---|
| | *Black Pepper.* | | | % | % | |
| 15065 | E. O. Smith, Springfield, Mass. Gold Seal | *Willimantic.* Blish & Son, 64 Church st. | 10 | 8.25 | 2.02 | Excess of ash and sand. |
| | *Cayenne.* | *Middletown.* | | | | |
| 15570 | Sold in bulk | D. J. Hartman, 530 Main st. | 15 | ...... | ...... | Maize product, coal-tar dye. |
| | | *New Britain.* | | | | |
| 15456 | Sold in bulk | Wray & Co., Hartford ave. and Spring st. | 10 | ...... | ...... | Maize product. |
| | *Mustard.* | *Bristol.* | | | | |
| 15101 | Sold in bulk | C. H. Beaudon, Laurel st. | 10 | ...... | ...... | Wheat product, turmeric. |
| | | *Derby.* | | | | |
| 14882 | Sold in bulk | James McEnerney, 75 Elizabeth st. | 10 | ...... | ...... | Wheat product, turmeric. |
| | | *Hartford.* | | | | |
| 14801 | Sold in bulk | Dow's Grocery, 2 Church st. | 8 | ...... | ...... | Wheat product, turmeric. |
| 14800 | *The Standard Tea House, Hartford.* | *J. H. McGuire, 1019 Main st.* | 10 | ...... | ...... | Wheat product, turmeric. |
| | | *New Britain.* | | | | |
| 14742 | Samuel S. Beard & Co. Pure | Winthrop Tea Co., 161 E. Main st. | 10 | ...... | ...... | Wheat product, turmeric. |
| 14736 | Sold in bulk | Wray & Co., Hartford ave. and Spring st. | 10 | ...... | ...... | Wheat product. |

TABLE XI.—SPICES, ADULTERATED OR BELOW STANDARD—*Continued.*

| Station No. | Brand. | Dealer. | Price per ¼ pound, cents. | Ash. | Sand. | Adulterants. |
|---|---|---|---|---|---|---|
| | *Mustard.* | *Stamford.* | | % | % | |
| 14938 | Sold in bulk | H. L. Wood, 276 Main st. | 12 | ..... | ..... | Wheat product, turmeric. |
| | | *Waterbury.* | | | | |
| 14858 | Sold in bulk | Eagle Grocery Store, 201 S. Main st. | 5 | ..... | ..... | Wheat product, turmeric. |
| 15281 | Rivkin Bros., Hartford. Superior Quality | Joseph Kudirka, 881 Bank st. | 10 | ..... | ..... | Wheat product, maize product. |
| 15289 | Sold in bulk | Union Supply Co., 118 S. Main st. | 10 | ..... | ..... | Wheat product, cassava starch, turmeric. |
| | *White Pepper.* | *Bridgeport.* | | | | |
| 14909 | John S. Sills & Sons, New York. Finest Quality | J. Lifsitz, 1314 Main st. | 10 | ..... | ..... | Cereal product (biscuit). |
| | | *New Haven.* | | | | |
| 15149 | Sold in bulk | Enterprise Specialty Co., 417 State st. | 10 | ..... | ..... | Wheat product. |
| | | *Norwich.* | | | | |
| 15031 | Sold in bulk | Thos. Wilson, 78 Franklin st. | 12 | ..... | ..... | Cassava starch. |
| | | *Torrington.* | | | | |
| 15295 | Sold in bulk | Barton Bros., 184 Main st. | 12 | ..... | ..... | Maize product. |

## VANILLA EXTRACT.

According to the United States Standards "vanilla extract is the flavoring extract prepared from vanilla beans with or without sugar or glycerine and contains in one hundred (100) cubic centimeters the soluble matters from not less than ten (10) grams of the vanilla bean." Tincture of vanilla of the United States Pharmacopœia, known commonly as vanilla extract, is prepared from vanilla beans, cane sugar, and dilute alcohol, 100 grams of the beans being used for each 1000 cc. of the extract. It will be noted that the proportion of vanilla beans is the same in both of the foregoing preparations.

The common adulterants of vanilla extract are tonka bean extract, artificial vanillin, artificial coumarin, and caramel. Artificial vanillin is identical with the chief flavoring principle of the vanilla bean, but the extract made from this substance lacks the true flavor of genuine vanilla extract, owing to the absence of other substances which cannot be successfully imitated. At the present time vanillin, itself an adulterant, is adulterated with acetanilid (antifebrine), which not only is worthless for flavoring but is injurious to health. Tonka beans are much cheaper than vanilla beans and have a ranker flavor due to coumarin, which is also prepared artificially for use in extracts.

**Examination of Samples.**—The samples collected by the station during the year were bought partly from druggists and partly from grocers. Twelve were not found adulterated, 15 were variously adulterated (see Table XII), and 19 were marked as compounds. All the adulterated samples contained coumarin, which may have been added either as tonka bean extract or as artificial coumarin.

Two samples (Nos. 15427 and 15468) also contained acetanilid which doubtless was originally an adulterant of the artificial vanillin used in the preparation of the extract. The results indicate that fully half the vanillin used was acetanilid. Thirteen of the adulterated samples were colored with caramel or a similar product.

The difference between adulterated and compound extracts is merely a matter of labelling. If suitably labelled, artificial extracts are legitimate articles of commerce. It is gratifying

TABLE XII.—ADULTERATED

| Station No. | Brand. | Dealer. |
|---|---|---|
| | | *Bridgeport.* |
| 15379 | Sold in druggist's vial | Dupee's Pharmacy, 59 Fairfield ave. |
| | | *Danbury.* |
| 15429 | Sold in druggist's vial | Baldwin & Macdonald, Main st. |
| 15427 | Danbury Grocery Co., Danbury, Conn. Danbury's Pure Concentrated | Danbury Grocery Co., 99 Town Hill ave. |
| 15428 | The Union Pacific Tea Co., New York. Sovereign | Union Pacific Tea Co., 253 Main st. |
| | | *Hartford.* |
| 15499 | Sold in druggist's vial | T. J. Blake, Jr., Albany ave. and East st. |
| | | *New Britain.* |
| 15468 | J. E. Murphy, New Britain. Absolutely Pure | J. E. Murphy, 500 Main st. |
| 15465 | Sold in druggist's vial | J. H. Lutz, 253 E. Main st. |
| | | *New Haven.* |
| 15322 | American Tea Co., New Haven, Conn. Centennial | Centennial American Tea Co., 363 State st. |
| 15319 | Sold in druggist's vial | Mark N. Sullivan, State and Pearl sts. |
| 15347 | The McKee Medicine Co., Middletown, Conn. Dr. McKee's Concentrated | E. Van Buren & Co., 33 Dixwell ave. |
| | | *New London.* |
| 15522 | Nichols & Harris, New London, Conn. | F. H. Davis & Co., 125 Bank st. |
| 15521 | Nichols & Harris, New London, Conn. | Nichols & Harris, State st. |
| 15523 | Chas. M. Taylor, New London, Conn. Taylor's Concentrated | G. H. Thomas, 61 Bank st. |
| | | *Norwich.* |
| 15542 | Lambert & Lowman, Detroit, Mich. Royal Branch Concentrated | C. W. Hill & Son, 145 Franklin st. |
| | | *Stamford.* |
| 15402 | Favorite | O. S. Brown, 54 Park Row |

VANILLA EXTRACT.

| Station No. | Price per bottle, cents. | Capacity of bottle, ounces. | Vanillin. | Coumarin. | Acetanilid. | Color. |
|---|---|---|---|---|---|---|
| | | | % | % | % | |
| 15379 | 20 | 4 | 0.22 | 0.07 | ---- | Natural. |
| 15429 | 35 | 4 | 0.15 | 0.04 | ---- | Natural. |
| 15427 | 10 | 1½ | 0.38 | 0.07 | 0.22 | Artificial. |
| 15428 | 20 | 2 | 0.87 | 0.09 | ---- | Artificial. |
| 15499 | 35 | 4 | 0.56 | 0.05 | ---- | Artificial. |
| 15468 | 10 | 2 | 0.28 | 0.07 | 0.16 | Artificial. |
| 15465 | 40 | 4 | 0.61 | 0.06 | ---- | Artificial. |
| 15322 | 20 | 2 | 0.12 | 0.04 | ---- | Artificial. |
| 15319 | 40 | 4 | 0.74 | 0.11 | ---- | Artificial. |
| 15347 | 20 | 2½ | 0.34 | 0.16 | ---- | Artificial. |
| 15522 | 35 | 4 | 0.07 | 0.03 | ---- | Artificial. |
| 15521 | 45 | 4 | 0.07 | 0.03 | ---- | Artificial. |
| 15523 | 25 | 2 | 0.24 | 0.14 | ---- | Artificial. |
| 15542 | 35 | 4 | 0.19 | 0.13 | ---- | Artificial. |
| 15402 | 10 | 2 | 0.39 | 0.05 | ---- | Artificial. |

to note that while in 1905, 47 extracts were classed as adulterated and only 15 were labelled as compounds, during the present year only 15 were adulterated while 19 were labelled compounds.

## LEMON EXTRACT.

"Lemon Extract," as defined by the United States Standards, "is the flavoring extract prepared from oil of lemon, or from lemon peel, or both, and contains not less than five (5) per cent. by volume of oil of lemon." Spirit or essence of lemon (commonly known as lemon extract) of the U. S. Pharmacopœia for 1890 is made from oil of lemon (50 cc.), lemon peel freshly grated (50 grams), and deodorized alcohol (sufficient to make 1000 cc.). This preparation is dropped from the Pharmacopœia of 1900 and in its place is given tincture of lemon peel made from shredded peel from the fresh fruit (500 grams) and alcohol (sufficient to make 1000 cc.).

Since the alcohol in a standard extract containing 5 per cent of lemon oil costs about four times as much as all the other constituents together, unscrupulous manufacturers are accustomed to reduce the expense of manufacture by substituting dilute alcohol.

But lemon oil is practically insoluble in dilute alcohol, hence by reducing the strength of the alcohol the manufacturer cuts out the lemon oil almost entirely, thus rendering the extract almost worthless for flavoring purposes.

A good extract, on dilution with half its bulk of water, should at once become cloudy from the separation of lemon oil, which later rises to the surface.

Many of the brands on the market contain so little lemon oil that it can hardly be detected either by chemical analysis or by the nostrils. They are commonly made either by shaking lemon oil with weak alcohol and removing the excess of oil, or by dissolving a little "citral" or other substitute in dilute alcohol. These extracts are usually colored a beautiful golden-yellow with turmeric tincture or, more commonly, a coal-tar dye. An ounce of such an extract selling for 10 cents contains material costing but a fraction of a cent, and almost worthless as a flavor.

**Examination of Samples.**—The samples purchased by the station may be classified as follows: not found adulterated (lemon oil over 5 per cent. by volume), 26; adulterated (lemon oil less than 5 per cent. by volume), 19; labelled compounds, 18; total 63.

*Adulterated Lemon Extract.*—Details with regard to the adulterated samples are given in Table XIII. With one exception the adulteration consisted in a deficiency of lemon oil and alcohol. Ten contained scarcely a trace of lemon oil and only one-fifth to a little over one-half of the amount of alcohol required for a pure extract. The others were somewhat better quality but all were far below standard.

In one sample the flavoring substance was a foreign essential oil with the odor of lemon grass oil.

One sample was colored with turmeric and 6 with other dyes which in nearly, if not every, case were of coal-tar origin.

*Compound Lemon Extract.*—As regards composition, the brands classed under this head were of the same general nature as those pronounced adulterated, the difference being in the labelling. While the labels used were much more truthful than formerly, they were still in many cases misleading. The word compound was often in letters much smaller than those of the name of the article and the formula, when given, was in small letters or so worded as to puzzle the reader. A number of brands, instead of being labelled "Compound Lemon Extract," were described as being "compounded from the best materials" which to the consumer suggests nothing as to their inferiority. The following are examples of obscure or misleading formulæ as given on labels.

"Formula compound.

70 Parts Hydro-Alcoholic Solution Oil Lemon.

30 Parts Aqua. Colored artificially with a trace of Turmeric."

"Formula.

99 Parts diluted Alcoholic Solution of Lemon Oil.

1 Part Solution of Artificial Lemon Color."

The word "Compound" in letters the same size as "Lemon Extract" conveys to the consumer the desired information an hereafter manufacturers must conform to this ruling.

TABLE XIII.—ADULTERATED LEMON EXTRACT. (LEMON OIL BELOW 5.00 PER CENT. BY VOLUME.)

| Station No. | Brand. | Dealer. | Price per bottle, cents. | Capacity of bottle, fluid ounces. | Specific gravity at 15.5° C. | Alcohol by weight. | Lemon oil by volume. Polariscopic method. | Lemon oil by volume. Mitchell's precipitation method. | Color. |
|---|---|---|---|---|---|---|---|---|---|
| | | *Bridgeport.* | | | | % | % | % | |
| 15373 | The Union Pacific Tea Co., New York. "Sovereign" | Union Pacific Tea Co., 1058 Main street | 20 | 2 | .9114 | 52.98 | 0.68 | 0.80 | |
| 15375 | Old Dominion Mfg. Co., Richmond, Va. Old Dominion | E. E. Wheeler, 1135 Main st. | 10 | 1½ | .9224 | 47.68 | 0.35 | 0.30 | Artificial |
| | | *Danbury.* | | | | | | | |
| 15433 | Danbury Grocery Co., Danbury, Conn. Danbury's Concentrated Lemon Flavoring | Danbury Grocery Co., 99 Town Hill ave. | 10 | 2 | .9374 | 41.88 | 0.00 | 0.20 | |
| 15430 | Queen City Mfg. Co., Newburgh, N. Y. Queen City Concentrated Lemon Flavoring | M. J. Shanley, 147 Main st. | 10 | 1½ | .9584 | 31.31 | 0.08 | 0.00 | |
| | | *Hartford.* | | | | | | | |
| 15498 | The Horton Cato Mfg. Co., Detroit, Mich. Royal | Wise, Smith & Co., Main st. | 10 | 2 | .9074 | 53.97 | 0.53 | 0.40 | |
| | | *Middletown.* | | | | | | | |
| 15565 | Sold in druggist's vial | Bergquist Bros., 588 Main st. | 40 | 4 | .8626 | 74.75 | 0.59 | 0.70 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 15566 | New England Tea Co., Middletown, Conn. New England Tea Co.'s Superior | New England Tea Co., 442 Main street | 20 | 2 | .9643 | 26.08 | 0.00 | 0.00 | Artificial |
| | | *New Britain.* | | | | | | | |
| 15470 | The *Pierce Mfg.* Co., *Danielson*, Conn. Pierce's Pure Concentrated | Wray & Co., Hartford ave. and Spring st. | 10 | 1½ | .9741 | 29.48 | 0.00 | 0.00 | |
| | | *New Haven.* | | | | | | | |
| 15343 | Star Extract Co., Boston, Mass. Extra Strength Star | D. M. Welch & Son., 28 Congress ave. | 10 | 2 | .9713 | 19.38 | 0.03 | 0.00 | Artificial |
| | | *New London.* | | | | | | | |
| 15517 | Chas. M. Taylor, New London, Conn., Lanman's Choice | C. M. Taylor, State and Main sts. | 35 | 4 | .8801 | 65.91 | 2.00 | 2.60 | |
| 15520 | Concentrated Extract Lemon | The Mohican Co., State st. | 10 | 2 | ---- | ---- | 0.06 | 0.00 | |
| | | *Norwalk.* | | | | | | | |
| 15388 | The John T. Doyle Co., New Haven, Conn. Doyle's Pure Concentrated. | Union Grocery Co., 10 Main st. | 10 | 1 | .9074 | 53.97 | 0.58 | 0.70 | |
| | | *Norwich.* | | | | | | | |
| 15540 | Disco Bros., Norwich, Conn. Gilt Edge | Disco Bros., 267 Main st. | 10 | 1½ | .9356 | 41.72 | 0.24 | 0.00 | |
| 15537 | Sold in druggist's vial | John A. Dunn, 50 Main st. | 30 | 4 | .8184 | 88.80 | 2.10 | 2.20 | |
| 15539 | Lambert & Lowman, Detroit, Mich. Royal Brand Concentrated | C. W. Hill & Son., 145 Franklin street | 20 | 4 | .9144 | 51.02 | 0.30 | 0.00 | Artificial |

TABLE XIII.—ADULTERATED LEMON EXTRACT. (LEMON OIL BELOW 5.00 PER CENT. BY VOLUME.)—*Concluded.*

| | Brand. | Dealer. | Price per bottle, cents. | Capacity of bottle, fluid ounces. | Specific gravity at 15.5° C. | Alcohol by weight. | Lemon oil by volume. | | Color. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Polariscopic method. | Mitchell's precipitation method. | |
| | | *South Norwalk.* | | | | | | | |
| 90 | W. A. Leggett & Co., New York. Victoria Brand XXX | United Grocery Co., 20 N. Main street | 20 | 2 | .9594 | % 28.57 | % 0.03 | % 0.00 | Artificial |
| | | *Stamford.* | | | | | | | |
| 07 | Durand Extract Co., Milburn, N.J. Durand's High Grade | H. L. Wood, 282 Main st. | 25 | 2 | .8513 | 77.21 | 2.40 | 3.20 | Turmeric |
| | | *Waterbury.* | | | | | | | |
| 82 | Sold in druggist's vial | G. T. Geddes, 826 Bank st. | 15 | 4 | .8304 | 87.75 | 0.00 | 3.20* | |
| | | *Willimantic.* | | | | | | | |
| 54 | The T. R. Sadd Co., Willimantic, Conn.. Perfectly Pure Highly Concentrated Purity Flavoring Extract | The T. R. Sadd Co., 760 Main street | 20 | 2 | .9394 | 40.02 | 0.59 | 0.50 | Artificial |

* Not lemon oil but a foreign essential oil.

## CREAM OF TARTAR.

Cream of tartar or potassium bitartrate (*potassii bitartras* of the apothecary) is purified argol, a deposit which settles out from wine in the cask. In should contain 99 per cent. of pure potassium bitartrate. The common substitutes are acid phosphate of lime, alum, and aluminium sulphate, all of which, like

TABLE XIV.—ADULTERATED CREAM OF TARTAR.

| Station No. | Brand. | Dealer. | Price per ¼ lb., cents. | Adulterants. |
|---|---|---|---|---|
| | | *Danielson.* | | |
| 15040 | Sold in bulk.. | A. H. Armington, 142 Main st. | 8 | Acid phosphate of lime, alum, maize starch. |
| | | *Hartford.* | | |
| 14789 | Sold in bulk.. | Union Grocery, 1030 Main st. | 10 | Acid phosphate of lime, alum, maize starch. |
| 14790 | Sold in bulk.. | Wise, Smith & Co., Main st. | 10 | Sulphate of lime, maize starch. |
| | | *Stamford.* | | |
| 14946 | Sold in bulk.. | Empire State Tea Co., Atlantic sq. | 12 | Acid phosphate of lime, alum. |

cream of tartar, react with bicarbonate of soda, liberating carbonic acid. These substitutes, also starch and sulphate of lime (plaster), are frequently used as adulterants of the genuine product.

TABLE XV.—ANALYSES OF ADULTERATED CREAM OF TARTAR.

| Station No. | Lime. | Alumina. | Phosphoric Acid. | Sulphuric Acid. | Starch. |
|---|---|---|---|---|---|
| | % | % | % | % | % |
| 15040 | 9.08 | 4.29 | 8.99 | 26.29 | 26.62 |
| 14789 | 9.20 | 3.80 | 8.64 | 24.69 | 23.71 |
| 14790 | 26.30 | .... | .... | 34.13 | 16.77 |
| 14946 | 27.18 | 0.21 | 15.12 | 20.71 | 2.12 |

**Examination of Samples.**—Seventy samples have been collected by the station, of which 4 were adulterated. Descriptions of the adulterated samples are given in Table XIV and analyses in Table XV. Nos. 15040 and 14789 were about the same in composition and consisted largely of acid phosphate of lime, alum, and sulphate of lime, mixed with about 25 per cent of starch, while No. 14946 contained acid phosphate of lime, a large percentage of sulphate of lime, but only a small amount of alum and starch. The most grossly adulterated sample was No. 14790, containing about 60 per cent. of anhydrous sulphate of lime together with 16.77 per cent. of starch.

## VINEGAR.

Of 124 samples submitted by the dairy commissioner 66 were below the legal standard in acidity, or solids, or both.

Two samples, sent by N. Dwight Platt, Milford, were examined with the following results:

| | | |
|---|---|---|
| No. 11316 | Solids 1.87 | Acidity 4.14 |
| No. 16317 | " 1.95 | " 4.57 |

A sample (No. 16197), sent by Ackley, Hatch & Marsh, New Milford, contained 2.72 per cent. of solids and 5.28 per cent. of acidity.

## MALT EXTRACT.

A bottle of malt extract, sent by a clergyman who found the same on sale in a no-license town, contained 2.69 per cent. of alcohol by weight or 3.45 per cent. by volume. The suspicion that this article was the cause of drunkenness in the town appears to be well founded.

## DIABETIC FOODS.

The necessity of excluding so far as possible from the diet of diabetic patients sugars and substances, such as starch and dextrin, yielding sugar with the digestive juices, has led to the introduction of saccharine and other coal-tar derivatives and preparations containing, or purporting to contain, no starch or starch derivatives, or else diminished amounts of these substances. The craving of the patient for sweets is sometimes satisfied, at least temporarily, by the use of saccharine, a coal-tar product several hundred times as sweet as sugar which is free, so far as diabetes is concerned, from the injurious properties of sugar, but the preparation of a harmless but palatable substitute for bread requires a special flour containing a relatively small percentage of starch and special methods of bread-making.

So-called diabetic flours may be made from wheat flour by washing out a portion of the starch and drying. If the process of washing is carried far enough, crude gluten is obtained containing very small amounts of starch, and from this, after drying, may be prepared gluten flour. Crude gluten, obtained as a by-product in the manufacture of wheat starch, is said to be utilized for the preparation of gluten flour as well as a concentrated cattle food. The removal of so large a proportion of the starch materially alters the physical characters of the flour and the bread made from it is quite different from ordinary bread. Sample No. 16298, Table XVI, is flour of this description and No. 18710, p. 164, is a biscuit made from this flour. Most of the commercial diabetic flours, however, are not true gluten flours since they still contain a considerable amount of starch—some of them so much as to render them positively dangerous for diabetic patients.

Not only all of the cereal grains but also most of the seeds of the legumes, such as field and lima beans, peas, and lentils, contain large amounts of starch and must be avoided by diabetics; the soja or soy bean, however, is a striking exception as it contains, when ripe, no true starch, or only traces. This

leguminous seed is an important food in Japan and is being used in this country for the manufacture of meal for the use of diabetics. Two analyses of soja bean meal are given in Table XVI, pp. 156-157, and of biscuit made from this product on p. 164.

The peanut, another leguminous seed, although very rich in oil, contains about 11 per cent. of starch, sugar, and dextrin, of which about half is starch.

Most of the nuts, including walnuts, Brazil nuts, almonds, and filberts, since they contain no starch and only small amounts of sugar and dextrin but are rich in protein and oil, are valuable additions to the diet of diabetics. Almond meal is used in the preparation of various biscuits and bread substitutes. The chestnut is a notable exception among nuts, in that it is rich in starch and poor in fat, the composition of the shelled nut being much the same as that of wheat flour; it is therefore entirely unsuited for the use of diabetics.

Casein prepared from skimmed milk is used for making a kind of bread entirely free from starch. Sample No. 18762, pp. 156-157, in a casein flour.

In making out dietaries for diabetic patients it should be borne in mind that starch, sugar, and dextrin are all about equally injurious since starch and dextrin are converted by the saliva and pancreatic juice into sugar (chiefly maltose) and it is the sugar, not the starch itself, which is directly injurious. For example, changing a portion of the starch into dextrin, as is done to some extent by toasting bread, does not render it less injurious, in fact it actually hastens the formation of sugar through the action of the digestive juices since dextrins are intermediate products in the charge. For this reason the sum of the percentages of starch, sugar, and dextrin, and not the starch alone, should be considered in valuing diabetic preparations.

**Examination of Samples.** The diabetic preparations analyzed were largely secured through the courtesy of Mr. James W. Thompson, Attorney at Law, Bridgeport, who, as an agent of the station, purchased the products in original packages direct from the manufacturers or their representatives. Additional samples of some of the products especially rich in starch were afterwards purchased from retailers in New Haven by an agent at the station.

*Chemical Analysis.* The names of the brands and the manufacturers together with the analyses are given in Table XVI. Only such products are included as were distinctly stated, either on the labels of the packages or in the circulars sent out by the manufacturers, to be for the use of diabetics. The percentages of protein or starch guaranteed by the manufacturers, whenever stated on the packages, are given in the second column after the names of the brands. In justice to the manufacturers it should be assumed that the guarantees for protein apply to the products as packed, at which time kiln-dried flours and freshly baked biscuit, etc., doubtless contained a smaller amount of moisture than after standing in the paper or pasteboard package. It should further be remembered that the percentage of true starch may be considerably lower than that of starch, sugar, and dextrin as determined together by us.

In all cases, for the sake of uniformity and to conform to common usage, the per cent. of protein was calculated by multiplying the per cent. of nitrogen by 6.25, although it has been shown that 5.70 is a more correct factor for wheat products and 6.37 for casein preparations. Because of the error thus introduced, the figures for protein in the wheat products, as given in the tables, are too high and for nitrogen-free extract (which is obtained by difference) are too low. The error thus introduced in the case of Nos. 16297-16299, which are exceptionally rich in protein, is sufficient to bring the percentages of nitrogen-free extract below those of starch, sugar, and dextrin, whereas the reverse should be true, as the nitrogen-free extract, strictly speaking, includes other substances in addition to those named.

Casoid Flour, No. 18762, a preparation consisting in large part of casein, contained 85.56 or 87.20 per cent. of protein according as the factors 6.25 or 6.37 are used. The sum of the water, ash, true protein ($N \times 6.37$), and fat is 100.17, indicating that the material contained no appreciable amount of other constituents.

*Microscopical Examination.* All of the samples of flour and meal examined, excepting those sold as casoid flour, wheat and barley, soja bean meal, almond meal, and nut meal, were shown by microscopic examination to be wheat products. The

TABLE XVI.—ANAL

| Station No. | Material. | Manufacturer. |
|---|---|---|
| | *Flour and Meal.* | |
| 16298 | Barker's Gluten Food, A. | Herman Barker, Somerville, |
| 16299 | Barker's Gluten Food, B. | " " " |
| 16297 | Barker's Gluten Food, C. | " " " |
| 16044 | 40% Gluten Flour | Battle Creek Sanatarium Foo |
| 16054 | 40% Gluten | " " " " |
| 16050 | Gluten Flour | Farwell & Rhines, Watertow |
| 18343 | Gluten Flour* | " " " |
| 18363 | Cresco Flour† | " " " |
| 16066 | Special Diabetic Food (Flour) | " " " |
| 16067 | Special Diabetic Food (Flour) | " " " |
| 18342 | Special Diabetic Food (Flour)† | " " " |
| 16071 | Glutosac Flour, 35% Proteids | The Health Food Co., New Y |
| 16072 | Protosac Flour, 40% Proteids | " " " " " |
| 16074 | Pure Washed Gluten Flour, 85% Proteids, 6% Carbohydrates, 9% Water | " " " " " |
| 16046 | Jireh Diabetic Flour | Jireh Diabetic Food Co., New |
| 16049 | Wheat and Barley | " " " " |
| 18347 | Wheat and Barley‡ | " " " " |
| 18349 | Flour‡ | " " " " |
| 16073 | Educator Standard Gluten Flour | Johnson Educator Food Co. |
| 16290 | Almond Meal | The Health Food Co., New Y |
| 16045 | Vegetable Gluten, 20% Starch | Theo. Metcalf Co., Boston |
| 16047 | Soja Bean Meal, 5.5% Starch | " " " " |
| 18709 | Soja Bean Meal, 7.63% Starch | " " " " |
| 6048 | Hoyt's Gum Gluten | The Pure Gluten Food Co., N |
| 6051 | Gum Gluten, Ground | " " " " " |
| 6052 | Gum Gluten, Self-raising | " " " " " |
| 6056 | Gum Gluten Breakfast Food | " " " " " |
| 6053 | Sanitas Nut Meal | Sanitas Nut Food Co., Ltd. Creek, Mich. |
| 8762 | Casoid Flour | Callard, Stewart & Watt, Ltd. |
| | *Bread, Biscuit, Rusk, etc.* | |
| 6068 | 40% Gluten Biscuit | Battle Creek Sanatarium Food |
| 6069 | Potato Gluten Biscuit | " " " " |
| 6070 | Pure Gluten Biscuit | " " " " |
| 6055 | No. 1 Proto Puffs, 78.86% Protein, 6.71 Starch | The Health Food Co., New Y |
| 6058 | Salvia Sticks | " " " " " |
| 6075 | Protosac Bread, 40% Protein | " " " " " |
| 6076 | Glutosac Bread, 35% Proteids | " " " " " |
| 6279 | Plain Glutosac Wafers, 33% Proteids | " " " " " |
| 6280 | Glutona, 35% Proteids | " " " " " |
| 6281 | Glutosac Zweiback, 35% Proteids | " " " " " |
| 6282 | Glutosac Butter Wafers, 35% Proteids | " " " " " |
| 6283 | Protosac Rusks, 40% Proteids | " " " " " |
| 6284 | Glutosac Rusk, 35% Proteids | " " " " " |
| 6285 | Diabetic Biscuit, 40% Proteids | " " " " " |
| 6278 | Jireh Whole Wheat Bread | Jireh Diabetic Food Co., New |
| 6289 | Jireh Diabetic Biscuit | " " " " |

* Purchased from D. M. Welch & Son., 28 Congress Ave., New Haven.
† Purchased from E. E. Nichols, 376 State St., New Haven.

BETIC FOODS.

| Water. | Ash. | Protein (nitrogen x 6¼). | Fiber. | Nitrogen-free extract. | Fat. | Starch, sugar and dextrin.* | Ash. | Protein (nitrogen x 6¼). | Fiber. | Nitrogen-free extract. | Fat. | Starch, sugar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Analysis of material as purchased. | | | | | | | Analysis calculated to water-free basis. | | | | | |
| % | % | % | % | % | % | %* | % | % | % | % | % | |
| 10.12 | 0.22 | 85.38 | 0.03 | 3.69 | 0.56 | 4.46 | 0.24 | 95.00 | 0.03 | 4.11 | 0.62 | 4 |
| 10.14 | 0.22 | 84.38 | 0.02 | 4.64 | 0.60 | 6.03 | 0.24 | 93.90 | 0.02 | 5.18 | 0.66 | 6 |
| 9.71 | 0.22 | 82.50 | 0.04 | 6.72 | 0.81 | 8.33 | 0.24 | 91.39 | 0.04 | 7.44 | 0.89 | 9 |
| 10.49 | 0.51 | 40.25 | 0.15 | 47.42 | 1.18 | 46.85 | 0.57 | 44.97 | 0.16 | 52.98 | 1.32 | 52 |
| 8.53 | 1.38 | 38.44 | 0.11 | 50.33 | 1.21 | 50.01 | 1.51 | 42.04 | 0.12 | 55.01 | 1.32 | 54 |
| 12.67 | 0.43 | 11.37 | 0.25 | 74.38 | 0.90 | 71.51 | 0.49 | 13.02 | 0.28 | 85.18 | 1.03 | 81 |
| 13.32 | 0.46 | 10.75 | 0.14 | 74.38 | 0.95 | 72.02 | 0.50 | 12.40 | 0.16 | 85.78 | 1.16 | 83 |
| 12.74 | 0.48 | 11.12 | 0.05 | 74.73 | 0.88 | ------ | 0.55 | 12.75 | 0.05 | 85.57 | 1.08 | --- |
| 12.02 | 1.93 | 14.25 | 1.37 | 67.47 | 2.96 | 58.33 | 2.19 | 16.20 | 1.55 | 76.70 | 3.36 | 66 |
| 10.27 | 1.60 | 14.20 | 1.07 | 70.11 | 2.75 | 62.11 | 1.78 | 15.83 | 1.19 | 78.14 | 3.06 | 69 |
| 12.39 | 1.28 | 12.75 | 0.62 | 70.35 | 2.61 | ------ | 1.46 | 14.55 | 0.70 | 80.31 | 2.98 | --- |
| 10.13 | 1.14 | 34.06 | 0 97 | 52.13 | 1.57 | 49.33 | 1.27 | 37.00 | 1.08 | 58.00 | 1.75 | 54 |
| 10.58 | 0.66 | 36.62 | 0.25 | 51.03 | 0.86 | 49.98 | 0.73 | 40.95 | 0.27 | 57.09 | 0.96 | 55 |
| 6.22 | 0.80 | 62.40 | 0.16 | 29.51 | 0.91 | 27.51 | 0.85 | 66.54 | 0.17 | 31.47 | 0.97 | 29 |
| 9.26 | 1.30 | 14.25 | 1.03 | 71.95 | 2.21 | 66.63 | 1.43 | 15.71 | 1.13 | 79 30 | 2.43 | 73 |
| 9.72 | 1.51 | 11.75 | 1.59 | 73.56 | 1.87 | 66.22 | 1.67 | 13.02 | 1.76 | 81.48 | 2.07 | 73 |
| 9 54 | 1.64 | 11.25 | 1.38 | 74.39 | 1.80 | ------ | 1.81 | 12.44 | 1.52 | 82.24 | 1.99 | --- |
| 10.98 | 1.32 | 12.12 | 1.11 | 72.63 | 1.84 | ------ | 1.48 | 13.62 | 1.25 | 81.58 | 2.07 | --- |
| 11.26 | 0.95 | 26.37 | 0.37 | 59.38 | 1.67 | 56.84 | 1.07 | 29.72 | 0.41 | 66 92 | 1.88 | 64 |
| 8.51 | 6.42 | 50.62 | 2.86 | 15.96 | 15.63 | 7.18 | 7.02 | 55.32 | 3.12 | 17.45 | 17.09 | 7 |
| 7.88 | 8.65 | 61.37 | 0.32 | 28.23 | 1.55 | 26.79 | 0.70 | 66.64 | 0.34 | 30.64 | 1.68 | 2ç |
| 7.75 | 4.38 | 39.87 | 3.85 | 25.09 | 19.06 | 8.95 | 4.75 | 43.22 | 4.17 | 27.20 | 20.66 | ç |
| ------ | ---- | 36.75 | ---- | ------ | ------ | ------ | ---- | ------ | ---- | ------ | ------ | -- |
| 11.19 | 0.96 | 31.82 | 0.33 | 54.15 | 1.55 | 51.95 | 1.08 | 35.83 | 0.37 | 60.98 | 1.74 | 58 |
| 6.92 | 0.99 | 50.13 | 0.48 | 39.62 | 1.86 | 38.55 | 1.06 | 53.90 | 0.51 | 42.53 | 2.00 | 41 |
| 10.79 | 4.53 | 37.87 | 0.45 | 45.41 | 0.95 | 42.86 | 5.08 | 42.45 | 0.50 | 50.91 | 1.06 | 48 |
| 9.11 | 1.07 | 53.37 | 0.33 | 34.48 | 1.64 | 31.04 | 1.17 | 58.75 | 0.36 | 37.92 | 1.80 | 34 |
| 3.03 | 2.17 | 29.00 | 2.01 | 12.13 | 51.66 | 8.94 | 2.24 | 29.90 | 2.07 | 12.51 | 53.28 | ç |
| 10.01 | 2.46 | 85.56 | ---- | ------ | 0.50 | none | 2.73 | 95.08 | ---- | ------ | 0.56 | n‹ |
| 7.45 | 1.55 | 35.75 | 0.13 | 54.10 | 1.02 | 52.64 | 1.68 | 38.63 | 0.14 | 58.45 | 1.10 | 56 |
| 8.15 | 0.82 | 80.00 | 0.03 | 10.64 | 0.36 | 9.84 | 0.89 | 87.10 | 0.03 | 11.59 | 0.39 | 10 |
| *7.53* | *0.99* | *80.25* | *0.16* | *10.31* | *0.76* | *9.07* | *1.07* | *86.79* | *0.17* | *11.15* | *0.82* | ç |
| 8.55 | 1.32 | 75.88 | 0.08 | 13.15 | 1.02 | 9.86 | 1.44 | 82.98 | 0.08 | 14.39 | 1.11 | 10 |
| 6.62 | 7.45 | 39.19 | 1.91 | 24.06 | 20.77 | 18.66 | 7.98 | 41.96 | 2.04 | 25.78 | 22.24 | 19 |
| 27.30 | 1.44 | 32.47 | 0.22 | 36.97 | 1.60 | 33.12 | 1.98 | 44.66 | 0.30 | 50.86 | 2.20 | 45 |
| 31.51 | 1.88 | 27.42 | 0.42 | 36.11 | 2.66 | 29.90 | 2.74 | 40.07 | 0.61 | 52.70 | 3.88 | 43 |
| 6.13 | 3.54 | 29.44 | 1.52 | 49.77 | 9.60 | 41.60 | 3.77 | 31.36 | 1.62 | 53.02 | 10.23 | 44 |
| 4.77 | 2.48 | 22.06 | 0.30 | 58.60 | 11.79 | 54.88 | 2.60 | 23.17 | 0.31 | 61.54 | 12.38 | 57 |
| 7.62 | 2.45 | 32.50 | 1.21 | 49.33 | 6.89 | 40.93 | 2.65 | 35.18 | 1.31 | 53.40 | 7.46 | 44 |
| 4.71 | 3.76 | 27.62 | 1.63 | 49.41 | 12.87 | 41.24 | 3 94 | 28.99 | 1.71 | 51.85 | 13.51 | 43 |
| 5.90 | 2.01 | 40.87 | 0.53 | 48.66 | 2.03 | 43.90 | 2.13 | 43.44 | 0.56 | 51.72 | 2.15 | 46 |
| 4.48 | 2.70 | 36.50 | 0.88 | 51.63 | 3.81 | 42.48 | 2.82 | 38.21 | 0.92 | 54.06 | 3.99 | 44 |
| 4.67 | 3.10 | 28.12 | 0.34 | 54.75 | 9.02 | 51.10 | 3.25 | 29.50 | 0.35 | 57.44 | 9.46 | 53 |
| 39.18 | 1.79 | 9.36 | 0.61 | 48.68 | 0.38 | 43.83 | 2.94 | 15.39 | 1.03 | 80.02 | 0.62 | 72 |
| 6.34 | 2.01 | 14.75 | 0.94 | 72.30 | 3.66 | 65.44 | 2.14 | 15.75 | 1.00 | 77.21 | 3.90 | 69 |

* Determined by the diastase method, without previous washing with water,
lated as starch.

TABLE XVI.—ANALYSI

| tion o. | Material. | Manufacturer. |
|---|---|---|
| | *Bread, Biscuit, Rusk, etc.* | |
| 48 | Jireh Diabetic Biscuit* | Jireh Diabetic Food Co., New Y |
| 96 | Jireh Wheat Nuts | " " " " " |
| 58 | Jireh Wheat Nuts† | " " " " " |
| 59 | Jireh Diabetic Rusks† | " " " " " |
| 86 | Dr. Johnson's Gluten Wafers | Johnson Educator Food Co., B |
| 87 | Dr. Johnson's Diabetic Biscuit | " " " " |
| 88 | Dr. Johnson's Almond Biscuit | " " " " |
| 92 | Dr. Johnson's Educator Crackers, Greseni Gluten | " " " " |
| 93 | Dr. Johnson's Glutine, Greseni Gluten | " " " " |
| 94 | Dr. Johnson's Gluten Rusk, Greseni Gluten | " " " " |
| 61 | Casoid Biscuits | Callard, Stewart & Watt, Ltd., Lo |
| | *Paste, etc.* | |
| 59 | Sanitas Nut Butter | Sanitas Nut Food Co., Ltd., New |
| 60 | Sanitas Nuttolene | " " " " " " |
| 63 | Sanitas Almond Butter | " " " " " " |
| 65 | Sanitas Protose | " " " " " " |
| | *Cocoa.* | |
| 95 | Jireh Diabetic Cocoa | Jireh Diabetic Food Co., New Y |
| 46 | Jireh Diabetic Cocoa* | " " " " " |
| | *Baking Powder.* | |
| 52 | Jireh Diabetic Baking Powder | Jireh Diabetic Food Co., New Y |
| 57 | Jireh Diabetic Baking Powder† | " " " " " |

* Purchased from The S. W. Hurlburt Co., 1074 Chapel St., New Haven.
† Purchased from R. T. Whiting, 961 Main St., Bridgeport.

samples with less than 15 per cent. of protein had the appearance of being untreated mill products with or without the bran coats and germ. Some were gritty, that is felt rough between the fingers as compared with ordinary wheat flour, which feels soft and smooth. The starch was nearly or quite normal in its appearance under the microscope, showing that it had not been gelatinized as in the manufacture of true gluten flour.

The gluten flours and other flours made from wheat containing 26 per cent. and upward of protein, showed under the microscope flakes of crude gluten, i. e. a dried mixture of gluten and starchy matter, the latter in some cases being gela-

DIABETIC FOODS—*Continued.*

| Station No. | Analysis of material as purchased. | | | | | | | Analysis calculated to water-free | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water. | Ash. | Protein (nitrogen x 6¼). | Fiber. | Nitrogen-free extract. | Fat. | Starch, sugar and dextrin.* | Ash. | Protein (nitrogen x 6¼). | Fiber. | Nitrogen-free extract. | Fat. |
| | % | % | % | % | % | % | % | % | % | % | % | % |
| 8348 | 8.90 | 2.25 | 13.12 | 1.22 | 70.57 | 3.94 | ...... | 2.47 | 14.41 | 1.34 | 77.46 | 4.3 |
| 6296 | 7.57 | 2.33 | 19.00 | 1.00 | 54.55 | 15.55 | 50.13 | 2.52 | 20.56 | 1.08 | 59.01 | 16.8 |
| 8358 | 5.95 | 3.21 | 21.00 | 1.16 | 46.41 | 22.27 | ...... | 3.41 | 22.33 | 1.23 | 49.35 | 23.6 |
| 8359 | 8.69 | 3.06 | 14.62 | 0.91 | 67.71 | 5.01 | ...... | 3.35 | 16.02 | 0.99 | 74.15 | 5.4 |
| 6286 | 6.85 | 0.93 | 30.31 | 0.29 | 61.25 | 0.37 | 57.00 | 0.99 | 32.54 | 0.31 | 65.77 | 0.3 |
| 6287 | 5.90 | 1.89 | 25.31 | 0.39 | 59.03 | 7.48 | 54.85 | 2.01 | 26.90 | 0.41 | 62.73 | 7.9 |
| 6288 | 5.31 | 2.07 | 29.00 | 0.46 | 54.34 | 8.82 | 50.00 | 2.18 | 30.63 | 0.48 | 57.40 | 9.31 |
| 6292 | 6.15 | 2.94 | 23.00 | 0.21 | 63.09 | 4.61 | 57.86 | 3.13 | 24.51 | 0.22 | 67.23 | 4.91 |
| 6293 | 6.37 | 2.58 | 21.87 | 0.56 | 67.86 | 0.76 | 63.05 | 2.75 | 23.36 | 0.59 | 72.49 | 0.81 |
| 6294 | 6.23 | 2.98 | 22.12 | 0.33 | 68.06 | 0.28 | 63.27 | 3.18 | 23.59 | 0.35 | 72.59 | 0.2 |
| 8761 | 7.82 | 3.92 | 63.00 | .... | ...... | 17.34 | 8.07 | 4.25 | 68.35 | .... | ...... | 18.81 |
| 6059 | 0.17 | 2.85 | 28.81 | 3.66 | 13.97 | 50.54 | 9.09 | 2.85 | 28.86 | 3.66 | 14.00 | 50.6 |
| 6060 | 55.24 | 2.22 | 12.69 | 1.82 | 6.24 | 21.79 | ...... | 4.96 | 28.35 | 4.06 | 13.94 | 48.6 |
| 6063 | 0.90 | 2.93 | 22.62 | 3.92 | 8.11 | 61.52 | 3.65 | 2.95 | 22.82 | 3.95 | 8.20 | 62.0 |
| 6065 | 62.23 | 1.54 | 22.62 | 0.88 | 3.54 | 9.19 | ...... | 4.08 | 59.90 | 2.33 | 9.36 | 24.3 |
| 6295 | 3.06 | 4.29 | 20.56 | 3.57 | 50.71 | 17.81 | 32.58 | 4.42 | 21.21 | 3.68 | 52.32 | 18.3 |
| 8346 | 7.32 | 3.89 | 19.12 | 3.40 | 47.91 | 18.36 | 29.03 | 4.19 | 20.63 | 3.67 | 51.70 | 19.81 |
| 6062 | ...... | .... | ...... | .... | ...... | ...... | 14.25 | .... | ...... | .... | ...... | ..... |
| 8357 | ...... | .... | ...... | .... | ...... | ...... | 15.84 | .... | ...... | .... | ...... | ..... |

* Determined by the diastase method, without previous washing with wa
alculated as starch.

tinized. Some of the samples consisted entirely of this material, while others contained in addition what appeared to be untreated flour with normal starch grains.

The samples claimed to be wheat and barley, soy bean meal, and almond meal were true to name.

The bread, biscuit, and rusks for the most part showed under the microscope only wheat starch distorted by cooking, wheat tissues, and, in the case of those with high protein, gluten flakes like those found in the flour.

Salvia Sticks, No. 16058, contained a wheat product, and also, judging from the taste, an almond product. Dr. John-

son's Almond Biscuit, No. 16288, is stated to be made from gluten flour and almond nuts; no other constituents were found under the microscope.

Of the pastes, almond butter was true to name, and nut butter contained peanuts and probably other nuts.

No starch was detected in Casoid Flour, but Casoid Biscuit, notwithstanding the claims of the manufacturers, was found to contain starchy matter and tissues of a cereal.

Jireh Diabetic Cocoa contained a cereal flour and the baking powder made by the same company contained corn starch.

*Discussion of Results.* As has been stated, the products packed in pasteboard cartons absorb a certain amount of moisture from the air, thus diminishing to a corresponding degree the percentages of the other constituents. Calculated to the water-free basis, nearly all the samples, guaranteed to contain a certain per cent. of protein, fulfill the claims of the manufacturers.

All of the wheat preparations contained a certain amount of starch although in most of them the percentage was considerably reduced. The beneficial results from their use is not due solely to the reduced percentage of starch but also to the increased percentage of protein. The products are "richer" or "heartier" and the patient eats less of them. For example, ordinary wheat flour contains about 75 per cent. of starch and 11 per cent. of protein, whereas some of the diabetic flours examined contain about 50 per cent. of the former constituent and about 40 per cent. of the latter. Pound for pound, the amount of starch is reduced only to two-thirds the original amount, but the protein has been increased nearly fourfold, so that 25 parts of the preparation contain as much protein as 100 parts of the original but only one-sixth (one-quarter of two-thirds) as much starch. But a gluten flour with any considerable amount of carbohydrates (for example over 10 per cent.) should be used in very small amount, if at all, by diabetics. A safe flour for those suffering with the disease is casein flour entirely free from carbohydrates or else a vegetable flour containing the smallest possible amount of these substances, such as may be prepared from soja beans by simply grinding with removal of the hulls, from almonds and other starch-free nuts after expressing a portion of the fat, or from

wheat after washing sufficiently to remove nearly all the starch. A guarantee as to protein and starch content should be furnished with each product so that physicians can calculate dietaries for their patients.

Casoid Flour fully meets the claims of the manufacturers, being *entirely* free from carbohydrates, but Casoid Biscuit contain a small amount of starchy matter (starch, sugar, and dextrin 8.76 per cent.) *notwithstanding the guarantee that they* are free from starch and sugar. These biscuit, while not fulfilling the claims of the manufacturers, are among the least objectionable of the bread substitutes examined.

Attention should be called to the preparations of Farwell & Rhines and the Jireh Diabetic Food Company, which contain large percentages of starch but are not especially rich in protein. For comparison, the analyses of several of the preparations of these manufacturers and of wheat flour are given in the following tabular statement:

| | Farwell & Rhines Gluten Flour No. 16050 | Farwell & Rhines Special Diabetic Food (Flour) No. 16066 | Jireh Diabetic Flour No. 16046 | Wheat Flour Average* | "Entire Wheat Flour" (Wiley)† | Macaroni Wheat Flour Av. of 72 Analyses (Shepard)‡ |
|---|---|---|---|---|---|---|
| | % | % | % | % | % | % |
| Water | 12.67 | 12.02 | 9.26 | 12.42 | 12.08 | ..... |
| Ash | 0.43 | 1.93 | 1.30 | 0.48 | 0.90 | ..... |
| Protein (N × 6.25) | 11.37 | 14.25 | 14.25 | 10.84 | 13.75 | 15.28 |
| Fiber | 0.25 | 1.37 | 1.03 | 0.18 | 0.74 | ..... |
| Nitrogen-free extract | 74.38 | 67.47 | 71.95 | 74.99 | 70.60 | ..... |
| Fat | 0.90 | 2.96 | 2.21 | 1.09 | 1.93 | ..... |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | ..... |

* Jenkins and Winton: Compilation of Analyses of American Feeding Stuffs. *U. S. Dept. Agr., Office of Experiment Stations.* Bull. No. 11, 1892, p. 126.

† U. S. Dept. Agr., Div. Chem., Bull. No. 13, part 9, 1898, pp. 1239, 1256.

‡ S. Dak. Agr. Exp. Sta., Bull. 82, 1903, pp. 23–26. The percentage of N × 5.7 given by Shepard has been recalculated using the factor 6.25.

These analyses fail to show any very decided advantage of the preparations of the firms named, for the use of diabetic patients, over ordinary wheat flour. Microscopic examination proved that all of them contained large amounts of wheat starch with no marked difference from that of wheat flour.

In a circular letter in our possession, Farwell & Rhines make the following misleading and grossly unscientific statements:

"It is now conceded by the best authorities in America and Europe, that a rather liberal diet, with a certain amount of carbohydrates (starch and sugar), judiciously prepared, is essential to the successful treatment of Dyspepsia and Diabetes."

. . . . .

"Our 'Special Diabetic Food' is for the more marked cases of Diabetes, where a stricter diet is required: It is a pure wheat product from about two per cent. of the most carefully chosen wheat, a little less palatable and attractive than our 'Cresco Flour' but the mass of unsolicited testimony from the best medical authorities, and Diabetics, who owe health and even life to its merit as a food, is decisive and convincing."

The following is quoted from their booklet:

"No flour that will make bread fit to eat can be entirely free from starch. Even bran, which is unfit for human food, contains quite a percentage of starch. 'Pure Gluten' will make gum, *not* bread. Our claim is that, because of careful elimination of objectionable elements, and skillful combination of the vital properties of the cereal, in the manufacture of our Special Diabetic Food—Bread, Biscuit, Gems, Griddle Cakes, etc., made from it are reliable and nutritious in the highest degree, free from deleterious, indigestible matter, and as nearly free from starch as practicable to make such products. The invalid does not tire of their use.

In price, quality and results it is unequaled. A fair trial will prove it. We think no Diabetic or Dyspeptic can afford to tamper with other flours."

Farwell & Rhines also give in their circulars endorsements of physicians and patients but fail to state the percentages of protein and carbohydrates in their products, which information is of chief importance in determining their value.

The Jireh Diabetic Food Company designate their foods as "starch-changed" but our analyses and microscopic examinations do not indicate that the change, if any, is of a kind that renders the materials less objectionable for diabetic use.

The following preposterous statements from the circular of this company are contrary to the best medical experience since they urge the use of the very food elements which have been shown, without question, to most seriously aggravate the disease:

"The old plan of taking the starch out of the flour and making what is called Gluten bread was a serious mistake.

The starch is an important nutriment, leaving it out impoverishes the food and destroys the proper nutritive balance.

When the Starch *is changed* and left in, a food that is *physiologically correct* is produced, as in the JIREH DIABETIC FOODS.

No one, and especially diabetics, can thrive long on a food that is free of starch; hence the iodiocy of separating it from the gluten and other elements.

Nor can diabetics use ordinary bread-stuffs containing starch; hence the wisdom of changing the starch so as to make it soluble and digestible."

. . . . .

"The exact chemical change in the starch is very similar to the change wrought by the ptyaline in the saliva during mastication, in the mouth of a healthy person."

. . . . .

"As to the starch reactions and how they differ from ordinary unconverted starch, it must be remembered that the ordinary tests do not apply to this food."

. . . . .

"Such proofs are so convincing that patients will continue the use of them, even though their physicians, through fear of the starch, will not be responsible until the positive clinical proofs overcome their prejudices."

Attention should be called to the cocoa of the Jireh Diabetic Food Company. Pure cocoa contains about 15 per cent. of starch, sugar, and dextrin, which should be taken into account in calculating diabetic dietaries. Jireh Cocoa contains not only the carbohydrates of cocoa but an added quality in the form of a cereal product stated in the circulars to be "starch-changed prepared barley," the amount of starch, sugar, and dextrin being about twice as much as in pure cocoa.

Jireh Diabetic Baking Powder contains over 14.0 per cent. of starch. Starch to the extent of about 25 per cent. is a common constituent of baking powders, being used to prevent the products losing strength on keeping. It can be made, however, without any starch or the cook can substitute for baking powder the proper proportion of cream of tartar and bicarbonate of soda, both of which are free from starch.

*Homemade Diabetic Biscuit.* Analyses have been made of two kinds of biscuit or muffin made in the family of a diabetic patient, one from Barker's Gluten Food A, the other from *Metcalf's Soja Bean Meal. Of course other flours of similar* composition could be used in place of the ones named. Both kinds of biscuit were very palatable and would prove an acceptable addition to the diet of those not suffering from diabetes. The recipes after which they were made follow:

Gluten Meal Biscuit:—"To one egg add one heaping saltspoonful of salt and beat; then add 6 tablespoonfuls of cold water and beat until quite thick or until it becomes in quantity from one to one and one-half pints, and into this beat one tablespoonful of thin cream; add 2 heaping tablespoonfuls of dry gluten, stir this into the previous mixture; stir occasionally during one-half hour until of the consistency of thick gruel; bake 35 minutes in well buttered muffin pans in hot oven."

Soja Bean Meal Biscuit (Muffins or Popovers):—"Cream, one cup, eggs two, baking power one teaspoonful, salt to taste, Soja Bean Meal to make a batter not too thick, make into eight cakes."

The following are the analyses:

| | No. 18710 Biscuit Made from Gluten Food. | | No. 18711 Biscuit. Made from Soja Bean Meal. | |
|---|---|---|---|---|
| | *In original.* | *Calc. water-free.* | *In original.* | *Calc. water-free.* |
| Water | 25.58% | .... | 27.66% | .... |
| Ash | 2.35 | 3.16% | 5.33 | 7.37% |
| Protein | 50.91 | 68.41 | 16.71 | 23.10 |
| Fiber | 0.64 | 0.86 | 1.55 | 2.14 |
| Nitrogen-free extract | 3.18 | 4.27 | 12.84 | 17.75 |
| Fat | 17.34 | 23.30 | 35.91 | 49.64 |
| | 100.00 | 100.00 | 100.00 | 100.00 |

Both of these biscuits appear to be well suited for diabetic patients, as they contained comparatively low percentages of nitrogen-free extract. Although the soja bean biscuit contained about four times as much nitrogen-free extract as the gluten biscuit, it should be borne in mind that, as appears from the analyses of the flours given in Table XVI, only about one-third the nitrogen-free extract of the soja bean meal is starch, sugar, and dextrin, also that the nitrogen-free extract as given for the gluten foods is too low owing to the use of an erroneous factor for protein. With our present knowledge it may be

safe to assume that both biscuits are about equally unobjectionable so far as their carbohydrate constituents are concerned. They are, however, of a very different nature as regards protein and fat, the soja bean biscuit being relatively rich in fat whereas the gluten biscuit is rich in protein. Practical trials alone can decide which is the more wholesome. It seems probable that both can be used to advantage, thus serving to relieve in a measure the monotony of the diet.

In conclusion, the writer desires to express his gratitude to Professor Graham Lusk of the University and Bellevue Hospital Medical College, New York, a recognized authority on diabetes, who has kindly furnished valuable information as to the diet suitable for diabetics, and again to Mr. Thompson for his generous coöperation.

## MACARONI.

A sample of Hoyt's Gluten Macaroni (No. 16057) contained as follows:

| | Analysis of material as purchased. | Analysis calculated to water-free basis. |
|---|---|---|
| Water | 10.34% | .... |
| Ash | 0.74 | 0.82% |
| Protein (Nitrogen × 6¼) | 41.37 | 46.15 |
| Fiber | 0.29 | 0.32 |
| Nitrogen-free extract | 46.28 | 51.62 |
| Fat | 0.98 | 1.09 |
| | 100.00 | 100.00 |
| Starch, sugar, and dextrin* | 46.22 | 51.54 |

This material might properly be considered with the diabetic foods, as it contains about three times as much protein as ordinary imported macaroni and about twice as much as the richest heretofore examined at this station. (See Report for 1901, pp. 196-203.)

## MISCELLANEOUS.

One sample each of corn starch, "Force," vanilla extract and honey, sampled by consumers, were not found adulterated.

* Determined by the diastase method, without previous washing with water, and calculated as starch.

## Table XVII.—Summary of the Results of Examinations of Food Products in 1906.

| | Not found adulterated. | Adulterated or below standard. | Compounds. | Total number examined. |
|---|---|---|---|---|
| *Sampled by Station.* | | | | |
| Chocolate Coated Candy | ---- | ---- | ---- | 64 |
| Coffee | 34 | 5 | 3 | 42 |
| Cream (Evaporated) | 3 | 5 | 0 | 8 |
| Cream Tartar | 66 | 4 | 0 | 70 |
| Diabetic Foods | ---- | ---- | ---- | 64 |
| Hamburg Steak | 9 | 12 | 0 | 21 |
| Korno | --- | ---- | ---- | 2 |
| Lard | 81 | 34 | 0 | 115 |
| Lemon Extract | 26 | 19 | 18 | 63 |
| Macaroni | 1 | 0 | 0 | 1 |
| Maple Sugar | 0 | 1 | 0 | 1 |
| Maple Syrup | 3 | 17 | 19 | 39 |
| Milk | 163 | 199 | 0 | 362 |
| Olive Oil | 80 | 11 | 11 | 102 |
| Oysters | 18 | 1 | 0 | 19 |
| Sausage | 12 | 76 | 0 | 88 |
| Spices | 204 | 27 | 2 | 233 |
| Vanilla Extract | 12 | 15 | 19 | 46 |
| Total | 712 | 426 | 72 | 1340 |
| *Sampled by Dairy Commissioner.* | | | | |
| Bologna Sausage | 27 | 17 | 0 | 44 |
| Butter | 3 | 3 | 10 | 16 |
| Codfish | 2 | 14 | 0 | 16 |
| Coffee | 0 | 2 | 2 | 4 |
| Cream | 3 | 0 | 0 | 3 |
| Cream of Tartar | 1 | 2 | 0 | 3 |
| Frankfort Sausage | 39 | 17 | 0 | 56 |
| Hamburg Steak | 2 | 0 | 0 | 2 |
| Korno | 2 | 0 | 0 | 2 |
| Lard | 8 | 9 | 3 | 20 |
| Lemon Extract | 0 | 3 | 0 | 3 |
| Molasses | 300 | 3 | 0 | 303 |
| Olive Oil | 3 | 3 | 2 | 8 |
| Pork Sausage | 47 | 5 | 0 | 52 |
| Spices | 14 | 9 | 1 | 24 |
| Sugar | 1 | 0 | 0 | 1 |
| Vanilla Extract | 5 | 2 | 3 | 10 |
| Vinegar | 62 | 62 | 0 | 124 |
| Total | 519 | 151 | 21 | 691 |
| *Sampled by Health Officers, Consumers and Dealers.* | | | | |
| Butter | ---- | ---- | ---- | 1 |
| Coffee Substitute | ---- | ---- | ---- | 1 |
| Corn Starch | 1 | 0 | 0 | 1 |
| Cream | 20 | 2 | 0 | 22 |
| Force | 1 | 0 | 0 | 1 |
| Honey | 1 | 0 | 0 | 1 |
| Malt Extract | ---- | ---- | ---- | 1 |
| Milk | 200 | 95 | 0 | 295 |
| Spices | 1 | 2 | 0 | 3 |
| Vanilla | 1 | 0 | 0 | 1 |
| Vinegar | 1 | 2 | 0 | 3 |

# PART III.

# COMMERCIAL FEEDING STUFFS.

By E. H. Jenkins and A. L. Winton.

## THE LAW REGULATING THEIR SALE.

Section 4591 of the general statutes of Connecticut so defines the term "concentrated commercial feeding stuff" that it covers practically all feeds *excepting the following:*—hay and straw, whole seeds, unmixed meal made directly from any one of the cereals or from buckwheat, and feed ground from whole grain and sold directly from manufacturer to consumer.

Section 4592 requires that every package of concentrated commercial feeding stuff shall bear a statement giving the name and address of manufacturer or importer, the number of net pounds in the package, the name of the article and the percentages of protein and fat contained in it.

Section 4593 requires every manufacturer, importer, agent, or seller to file with this station, upon request, a certified copy of the statement above described.

The penalty prescribed for violation of the foregoing sections is not more than $100 for the first offense and not more than $200 for each subsequent offense.

Section 4595 authorizes this station to take samples from any manufacturer, importer, agent, or dealer in a prescribed fashion and requires this station to analyze, annually, at least one sample of each brand which it has collected and to publish these analyses in station bulletins, "together with such additional information in relation to the character, composition and use thereof as may be of importance."

The dairy commissioner is charged with the enforcement of the provisions of these sections of the statutes.

In compliance with these requirements the following report has been prepared.

## SAMPLING OF COMMERCIAL FEEDING STUFFS.

During the fall of 1906, Mr. V. L. Churchill, the sampling agent of this station, visited 44 towns and villages of this state and took 237 samples of feeds in the way prescribed by law. These samples have been examined chemically and microscopically and the results appear in the following pages with appropriate discussion.

There are also given analyses of feeds which were sent to the station for analysis by individuals. Other samples of feeds have been sent for microscopic examination by other stations.

## EXPLANATIONS OF ANALYSES OF FEEDING STUFFS.

An analysis gives the percentage amounts of Water, Ash, Protein, Fiber, Nitrogen-free Extract and Fat.

*Percentage Amount* is the amount in 100. If the protein in a feed is 17.5 per cent., every 100 pounds of that feed contain 17.5 pounds of protein; and since a ton is twenty hundred pounds, a ton of the feed will contain twenty times 17.5 or 350 pounds of protein.

*Water.* However dry a feeding stuff appears to be, it always contains a considerable and variable quantity of water which cannot be seen or felt, but which can be driven out by heat. The amount of water thus present in feeding stuffs is constantly changing with the temperature and moisture-content of the air about them, and accordingly no very close comparison of different feeds is possible, unless the proportions of water they contain are known and comparison is made on perfectly dry or water-free substance.

*Ash* is what is left when the combustible part of a feeding stuff is burned away by heating to faint redness in a current of air. Besides sand, usually an accidental purity, the ash consists chiefly of lime, magnesia, potash and soda, combined with chlorine, and carbonic, sulphuric and phosphoric acids.

It is from some of these that the bones of the animal are constructed and repaired, and other mineral matters are as necessary to continued health and life as any of the so-called nutrients which the analysis takes separate account of.

The rations commonly fed, however, have a sufficient amount of these mineral matters to meet the wants of the animal, although the addition of salt and of phosphate sometimes has a noticeably favorable effect on the condition of the animal.

*Protein* is a general expression for the nitrogenous matters of a feed, and in this report the term simply means the nitrogen percentage multiplied by 6¼. It is a general and only approximate expression for the amount of those flesh-forming ingredients of feed which contain nitrogen as an essential constituent, which are the most costly and are absolutely essential for the building and repair of the tissues of the body. The protein bodies are those which should be most considered in buying feeds, for besides being the most expensive, they are less easily produced on the farm and their residues are more valuable than those of the other nutrients in the manure.

*Nitrogen-free Extract,* sometimes called *Carbohydrates,* includes starch, gum, sugar, and pectin bodies. They are readily extracted from the feeding stuff by water and dilute acid. While they cannot build up the tissues of the growing animal, or directly restore the waste and wear of the tissues of adults, they, together with fat, by their combustion within the body, maintain the animal heat, and in well nourished animals, supply the energy needed for the bodily functions and for any form of work.

*Fiber* is the essential constituent of the walls of vegetable cells and is seen in a nearly pure state in cotton fiber or paper pulp. It is the most insoluble part of the vegetable substance and of subordinate value in the ration.

*Ether Extract* includes fat oil, solid fat, wax, chlorophyl (the green coloring matter of plants) and other coloring matters, in brief anything which can be extracted from the perfectly dry feeding stuff by absolute ether. Its use in the ration is largely the same as that of the nitrogen-free extract, although the digested ether-extract has about 2.4 times as much heat-producing value as the digested nitrogen-free extract.

Experience has proven that for each special case of animal nutrition a special ratio of digestible proteins to digestible ether extract, fiber and nitrogen-free extract is the best and most economical, and within certain limits is necessary.

## THE USES OF ANALYSES OF FEEDING STUFFS.

These uses are several. First, by an analysis compared with the average of others, any buyer of a feed can see whether it is of the usual quality. Thus on page 199 the analysis of cotton seed meal, No. 18123, compared with the average of six analyses given on the same page, shows that it has four per cent. less of protein and nearly two per cent. less of fat than the average and is to that extent inferior.

Secondly, by an analysis compared with the manufacturer's guaranty the buyer can see whether in composition the feed meets what is claimed for it. Thus on page 213 the analyses of Continental Gluten Feed show that it is not a gluten feed in the ordinary acceptation of that term and that it contains about 3 per cent. less of protein and 1 per cent. less of fat than the manufacturer guarantees.

Thirdly, an analysis often shows clearly whether or not the feed is adulterated and may indicate also the form of adulteration. Thus 18213, J. & F. Winter Mixed Feed, pages 214 and 215, as appears from the remarks on page 185, is a fraudulent and adulterated article, being sold without guaranty or statement to show that it is a mixture of wheat feed with ground corn cobs.

It also makes clear the composition of mixtures which are sold under names which either convey no meaning or convey a false impression.

Fourthly, comparison of analyses of a number of kinds of feed with their prices will greatly help in deciding whether any one of them is worth to the feeder what is asked for it. Too often the prices of feeds bear no relation to their real feeding value. This matter is discussed in following pages.

Lastly, the chief use of these tables by feeders should be as a guide to the skillful compounding of rations for farm animals. How this is done cannot be briefly explained within the limits of this report. A knowledge of the principles of cattle feeding is essential, which should be gathered by studying books which treat of the principles of cattle-feeding and of the art of compounding rations.

## DISCUSSION OF THE ANALYSES.

The microscopical and chemical work in connection with these analyses has been done by Dr. Winton and under his direction, with the coöperation of Mr. Bailey, Miss Barber and Mr. Shanley; the results have been discussed by the director.

### COTTON SEED MEAL.

Analyses on pages 198 and 199.

Of the six samples examined, four fail to meet the seller's guaranty of protein,* as follows:

| | | | |
|---|---|---|---|
| 18167 | Owl Brand, F. W. Brode & Co. | Protein deficient by | 1.75 per cent. |
| 18123 | Green Diamond Brand, | " " " | 4.75 " |
| 18243 | " " " | " " " | 1.63 " |
| 18199 | Star Brand, T. & R. S. Wells. | " " " | 2.50 " |

The Green Diamond brand is marked Prime Cotton Seed Meal, which according to the rules of the Cotton Seed Crushers Association has a minimum protein content of only 36.12 per cent. It is, therefore, guaranteed to contain from 5 to 7 per cent. more of protein than this grade of meal is expected to contain, which is ridiculous. It is only "choice" cotton seed meal that can be expected to show 43 per cent. of protein.

The cotton seed meal business appears to be thoroughly disorganized. Very large quantities are yearly brought into the state for use as a fertilizer as well as a feed. But last spring more than a third of the ninety samples analyzed fell below the usual guaranty of 6.5 per cent. nitrogen, 40.6 per cent. protein, some southern shippers rejected all claims for rebates on account of low grade meal, knowing that they could not be reached by legal process without too great expense to warrant the attempt, and cotton seed meal has never been so poor in quality or so high in price as at present.

* In this report the protein in a feed is considered in substantial agreement with the guaranty if it is not more than 0.7 per cent. below it. An allowance of one-tenth per cent. of nitrogen is made in comparing the actual and guaranteed composition of fertilizers (to cover possible errors of sampling and analysis), and as protein is calculated from nitrogen by multiplying by 6¼, an allowance about 6¼ times as large as that for

The average percentage of nitrogen found in 91 analyses in the spring was 6.60; the average percentage found in 6 samples this fall was 6.4.

The average percentages of protein and fat, as determined at this station, and the average prices, quoted by retailers, at *the time the samples were drawn, have been as follows for* the last seven years:

| | 1900 | 1901 | 1902 | 1903 | 1904 | 1905 | 1906 |
|---|---|---|---|---|---|---|---|
| Number of Samples..... | 4 | 6 | 8 | 25 | 17 | 12 | 6 |
| Percentage of protein... | 43.9 | 44.4 | 43.0 | 43.2 | 43.4 | 40.75 | 40.06 |
| " " fat ...... | 8.6 | 9.8 | 10.3 | 9.2 | 9.6 | 8.02 | 8.41 |
| Average price .......... | $27.00 | 28.80 | 29.70 | 29.04 | 28.88 | 28.89 | 32.33 |

Until cotton seed meal becomes somewhat more constant in composition and the guaranties something more than a farce and the southern shippers are willing to make good the misrepresentation of their guaranties without legal process, feeders will do well to use other concentrated feeds which do not have these drawbacks.

*Cotton Seed Meal, sampled and sent by Purchasers.*

**16194.** Hunter Bros'. Prime Meal, guaranteed 38 per cent. protein, sent by S. E. Brown, Collinsville, contained 39.38 per cent. of protein.

**16132.** Star Brand, Prime Meal, sold by J. T. & R. S. Wells, Memphis, guaranteed 43 per cent. of protein, sampled by Fred D. Weed, Danbury, from stock of F. C. Benjamin & Co., contained 39.06 per cent. of protein or 3.94 per cent. less than was guaranteed. Here again "Prime Meal" is guaranteed to contain 7 per cent. more of protein than the minimum quantity prescribed for this grade by the Cotton Seed Crushers Association.

## Cotton Seed Feed.

Analyses on pages 198 and 199.

This is simply undecorticated Cotton Seed Meal, containing half as much protein as standard cotton seed meal contains, but costing seven-eighths as much per ton.

Undecorticated meal is a good cattle feed at the south, where *it is sold at a relatively low price, but it cannot be economical* here partly because the freight which is the same as for decor-

Two samples have been drawn by the station marked Glenwood Brand, sold by D. L. Marshall Co. Protein 22, fat 5. One sample meets the guaranty of protein, the other is 3.4 per cent. below it.

A single sample sent by F. D. Weed, Danbury, contained 24.44 per cent. of protein.

## Linseed Meal.

Analyses on pages 198 and 199.

"Linseed Meal," "Oil Meal" and "Flax Seed Meal" are trade names for ground flax seed from which more or less of the oil has been removed. By the "old process" the oil is partly removed by pressure, leaving from 5 to 10 per cent. in the meal. By the "new process" the oil is so far extracted by naphtha as to leave, usually, less than 2½ per cent. in the meal. New process meal is rather more uniform in composition and contains more protein than old process meal.

Six samples of new process and three of old process meal have been examined and all are of fair quality and unadulterated.

**18033** is guaranteed to contain 37 per cent. of protein, which is 1.56 per cent. more than the meal contains. The guaranties of the other new process meals, 36 protein and 1 of fat, are substantially met in every case. The same is true regarding the lower guaranties of the old process meal.

**18706.** Ground Flax Screenings, sent by E. Manchester & Sons, contained broken flax seed, with much green foxtail and other weed seeds.

## Rape Seed Meal.

A sample, 16362, bought of Chapin & Co., Boston, sampled and sent by E. Manchester & Sons, Winsted, had the following composition:

| | |
|---|---|
| Water | 9.55 |
| Ash | 13.86 |
| Protein | 21.87 |
| Fiber | 14.36 |
| Nitrogen-free Extract | 24.72 |
| Fat | 15.64 |

Rape seed meal is somewhat used as feed for cattle in Europe. It is stated that great care is necessary in feeding it to cows, for some lots contain half a per cent. of oil of mustard, which spoils the flavor of the butter.

### Entire Wheat Meal.

Analyses on pages 198 and 199.

A sample, 18208, from Quinnebaug Mills, has about the composition to be expected of whole wheat kernel.

### Wheat Products.

These are by-products in the manufacture of wheat flour. Several different processes of milling are in common use, yielding by-products which are not alike in composition.

Wheat Bran consists of the outer layers of the wheat berry, which are dark in color and do not easily pulverize.

Wheat Middlings, as found in the feed market, consist of inner layers of the covering of the berry, which are lighter in color and more easily pulverized than bran, and of other parts from which fine white flour cannot be made.

Many mills do not sell bran and middlings separately, but run them together, often with other waste wheat products, and sell the mixture as "Mixed Feed."

#### *Bran from Winter Wheat.*

Analyses on pages 198 to 201.

Analyses of twelve samples are given in the table. All are of good quality. In the two cases where guaranties were given the composition corresponded with them.

#### *Bran from Spring Wheat.*

Analyses on pages 200 and 201.

All of the samples had the usual composition. Sample 18212, Jas. Quirk Milling Co., though normal in composition, had an excess of weed seeds, oat hulls and other impurities.

Eleven of the 17 samples had the guaranty of composition which is required by law and in every case the analysis showed as much protein and fat as the guaranty called for. The guaranteed amount of protein ranged from 12.2 to 16 and the actual amount present from 14.62 to 16.25 per cent.

A single sample of bran tested for Wilson H. Lee, of Orange, bought of Abner Hendee, New Haven, contained 14.88 per cent. of protein, rather less than the average amount.

A sample of bran sent by Benj. Fenn, Milford, was stated to be quickly fatal to ducks, but no poisonous matter could be found in it.

### *Middlings from Winter Wheat.*

Analyses on pages 200 to 203.

Of the ten samples analyzed all are pure and of average composition and the composition of the three which have a guaranty corresponds with that guaranty.

### *Middlings from Spring Wheat.*

Analyses on pages 202 and 203.

All the samples appear to be pure and of average composition.

Of the 20 samples, 14 had the guaranties required by law and in all cases, but one, there was substantial agreement between composition and guaranty.

A sample of Washburn-Crosby's Middlings, 16138, sent by S. W. Hurlburt, New Haven, had the following composition:

| | |
|---|---|
| Water | 10.82 |
| Ash | 4.79 |
| Protein | 15.90 |
| Fiber | 9.16 |
| Nitrogen-free Extract | 53.16 |
| Fat | 6.17 |
| | 100.00 |

Its composition is somewhat different from the average of spring wheat middlings and microscopic examination showed it to contain a very large amount of ground weed seeds. The manufacturer advises us that in this particular shipment some screenings got into the middlings through an accident at the mill.

Washburn-Crosby's Middlings, 16600, sent by B. P. Davis, Yantic, had 16.25 per cent. protein; Pillsbury's Daisy Middlings, 16170, and Washburn-Crosby's Adrian Middlings,

16169, both sent by John H. Holman, Georgetown, contained 18.13 and 17.63 per cent. of protein, respectively.

### *Mixed Feed from Winter Wheat.*

Analyses on pages 202 to 205.

All of the 22 samples analyzed were pure and of good average composition.

Only three manufacturers gave the guaranty required by law, which in each case corresponded with the composition of the goods.

### *Mixed Feed from Spring Wheat.*

Analyses on pages 202 to 205.

There is but little difference in the composition of the 14 analyses given in the tables. All the samples were of fair quality.

In seven cases guaranties are given as required by law. The Wirthmore brand has 16 per cent. of protein instead of 17 guaranteed, and E. S. Woodworth's Feed has 16.12 instead of 17.5 as guaranteed.

A sample of Rex Mixed Feed from J. B. M. Kehler, St. Louis, and bought of Abner Hendee, New Haven, by W. H. Lee, Orange, contained 16.50 per cent. of protein.

*An examination of the analyses of wheat products made at* this station during the last eight years shows that, as a rule, to which there are some exceptions, middlings contain the highest percentage of protein, mixed feed ranking next and bran last.

The average percentages of protein are about as follows:

| Bran. | | Middlings. | | Mixed Feed. | |
|---|---|---|---|---|---|
| Winter. | Spring. | Winter. | Spring. | Winter. | Spring. |
| 15.8 | 15.9 | 17.0 | 17.9 | 16.8 | 16.9 |

## MAIZE MEAL.

Analyses on pages 204 and 207.

The four analyses given in the table show the usual composition of meal from old corn, none of them having more than 13.91 per cent. of moisture.

The following were sent for examination by purchasers:

Two samples of Corn Meal, A and B, sent by Ira Peck, Hartford, contained 8.75 and 9.69 per cent. of protein respectively, and the microscope showed the presence of no foreign matter.

A Meal and B Meal, said to be made by the Husted Milling Co., Buffalo, New York, sent by S. E. Brown, Collinsville, contained 8.06 and 10.12 per cent. of protein respectively.

A sample of white Corn Feed, 18309, sent by P. A. Holt, Farmington, appears to be a manufacturing by-product from which the chits or germs have been excluded, which accounts for the low percentage of fat. Its composition is as follows:

| | |
|---|---|
| Water | 10.97 |
| Ash | 1.00 |
| Protein | 8.87 |
| Fiber | 0.50 |
| Nitrogen-free Extract | 77.97 |
| Fat | 0.69 |
| | 100.00 |

## GLUTEN FEED.

Analyses on pages 206 and 209.

Seven different brands of Gluten Feed have been offered in the state this fall.

Manufacturers have reduced their guaranties to a reasonable basis so that they fairly represent the quality of the goods in most cases.

Study of the analyses shows that *Buffalo Cereal Co's. Gluten Feed* (mean of 2 analyses), has about one per cent. less of protein than is guaranteed.

*Buffalo Gluten Feed,* sold by Chas. M. Cox Co., Boston, mean of 9 analyses, averages over one per cent. more of protein than is guaranteed and no single sample contains substantially less protein than is guaranteed.

*Globe Gluten Feed,* (mean of 7 analyses,) contains about 1½ per cent. more nitrogen than is guaranteed, although one sample falls 2.4 per cent. below guaranty.

*Hubinger's Gluten Feed* has a protein guaranty altogether too high for the quality of the goods.

The protein found in three analyses was, 24.4, 23.3 and 24.1, whereas 27 per cent. is the guaranty.

A single sample of Hubinger's Gluten Feed, 18291, bought of Abner Hendee, New Haven, and sent by W. H. Lee, Orange, contained 24.12 per cent. of protein.

The average percentage found last year was 24.2, showing that the failure to meet the guaranty is not due to any temporary and unforeseen cause.

*Queen Gluten Feed* has a guaranty of 25 per cent. protein. Both analyses are below this, 24.50 and 22.25 respectively.

*Piel's Gluten Feed.* Only a single sample of this was found and it contained only 23.62 per cent. of protein, instead of 27.0 per cent. as guaranteed.

*Warner's Gluten Feed* is well up to its guaranteed composition in three out of the four analyses.

A sample of "Michigan Gluten," 16193, bought of Cressey & Co., Boston, by S. E. Brown, Collinsville, contained only 17 per cent. of protein.

## Hominy Feed.

Analyses on pages 208 and 211.

This material, also called "Hominy Chop" and "White Meal," is a by-product from hominy mills and breweries and is quite popular with dairymen.

Hominy Feed, with the names of the following firms upon the bags, did not bear the statement of composition which is required by the law concerning feeding stuffs: Allen Baker Co., N. Y.; Buffalo Cereal Co., Buffalo, N. Y.; Chapin & Co., Boston; Husted Mill and Elevator Co., Buffalo; A. F. Lane, N. Y.; Wm. M. Payne & Son, New York; J. E. Soper & Co., Boston.

In all cases where guaranties were given the composition of the goods agreed with them.

The composition of the different brands of hominy feed is quite uniform, the Star Feed alone, Nos. 18245, 18086, 18203 and 18219, showing by its lower protein and higher fiber the admixture of more cob.

A sample, 16490, sent by W. W. Thompson, Warehouse Point, contained 10.75 per cent. of protein.

Another sample, 17227, sent by Vine Hill Farm, Elmwood, contained 8.12 per cent. of protein, three per cent. less than the average amount.

## RYE FEED.

Analyses on pages 210 and 211.

In the table are 5 analyses of this feed which are quite uniform. Only one sample, 18237, sold by Jennings & Fulton, Boston, had a guaranty, as required by law, with which the composition of their brand corresponded.

A single sample, 16826, bought of Abner Hendee, New Haven, and sent by the Southington Lumber & Feed Co., was of average composition, containing 15.62 per cent. of protein.

## GROUND OATS.

Analyses on pages 210 and 211.

The single analysis is not widely different from that of oats, but contains more protein than the latter. The microscope shows the presence of corn meal, a wheat product and whole weed seeds. It is not straight oats.

## BUCKWHEAT MIDDLINGS.

Analyses on pages 210 and 211.

A single sample from the Quinnebaug Mills contains over 32 per cent. of protein and is a concentrated feed, sold at a low price, $22.00 per ton. The feed called "middlings" at this mill must be distinguished from "buckwheat middlings" in the trade, which are mixtures of much lower feeding value because they contain a considerable amount of hulls. For example, a sample of "buckwheat middlings," 18316, sent by P. A. Holt, Farmington, contained 16.25 per cent. of protein, and a buckwheat bran, 18317, sent by Mr. Holt, contained but 13.75 per cent.

## MALT SPROUTS.

Analysis on pages 210 and 211.

Barley, previously soaked in water, is allowed to germinate until the characteristic ferment, diastase, has developed, when the grain is killed by drying it. The barley sprouts become brittle and are removed from the grain before it is used for the "malting" of starch.

The four samples of sprouts, none of which has a guaranty of composition, are quite uniform in composition and of average quality.

## Dried Distillery Grains.

Analyses on pages 210 to 213.

This is a residue from the whiskey or spirit manufacture. Certain grains, corn, or oats, or a mixture of the two ground fine and mixed with water, are first cooked to disintegrate and dissolve the starchy matter in them. This starch is then converted into sugar, usually by the action of barley malt, yeast is next added, which ferments the sugar, forming alcohol, and finally the whole fluid mixture is pumped into a closed vessel or still and the alcohol driven off by heat.

There is left a cooked, semi-liquid mass called "distillery slop," containing all that was in the grain originally, except the starch and sugar. This distillery slop if dried at once, or after putting through a filter press, makes an excellent cattle food.

*Fourex Grains,* made by the J. W. Biles Co., Cincinnati, is stated to be the by-product from making corn alcohol. The single sample drawn by our agent contains 30.31 per cent. protein, instead of 33 guaranteed, and 14.3 per cent. fat, being 3.3 per cent. more than guaranteed.

Four other samples, sent from another state, showed approximately the same quantities of protein and fat.

*Ajax Flakes,* sold by Chapin & Co., Boston, has 31.50 per cent. of protein, 33 being guaranteed.

*Corn Protegran,* Dewey Bros. Co., Blanchester, Ohio. The sample drawn by the station contains 28.56 per cent. protein, guaranteed 33, and 12.25 per cent. fat, guaranteed 14. The sample sent by Manchester & Sons shows 32 per cent. of protein.

*Biles' XX Distillers Dried Grains.* A single sample, 16361, sent by E. Manchester & Sons, guaranteed to contain 30 per cent. protein and 8 of fat, has the composition given below.

*Blue Ribbon Distillers Grains,* 16363, manufacturer unknown, sent by E. Manchester & Sons, has the composition also given below:

| | Biles XX | Blue Ribbon |
|---|---|---|
| Water | 4.56 | 6.75 |
| Ash | 1.69 | 2.55 |
| Protein | 31.87 | 23.06 |
| Fiber | 10.81 | 18.36 |
| Nitrogen-free Extract | 41.60 | 42.23 |
| Fat | 9.47 | 7.05 |
| | 100.00 | 100.00 |

## "Continental Gluten Feed."

Analyses on pages 212 and 213.

This material is evidently not gluten feed in the usual acceptation of the word, but distillery grains.

The two samples do not, in respect either of fat or of protein, meet the manufacturers' guaranty of 33 per cent. protein and 14 per cent. of fat. A sample, 16358, of this feed, sent by E. Manchester & Sons, had the composition given below.

Another, 16273, sent by Meech & Stoddard, Middletown, contained moisture 5.08, protein 29.37 and fat 13.28 per cent.

The average composition of all the distillery grains is given with other analyses in the following table:

| | 16358 | Average of Distillers' Grains |
|---|---|---|
| Moisture | 7.80 | 7.4 |
| Ash | 4.93 | 2.8 |
| Protein | 27.37 | 29.5 |
| *Fiber* | 8.46 | 11.3 |
| Nitrogen-free Extract | 39.22 | 37.1 |
| Fat | 12.22 | 11.9 |
| | 100.00 | 100.0 |

## Dried Brewers Grains.

Analyses on pages 212 and 213.

These consist of the dried residue of the mash from beer brewing and consist chiefly of barley grains deprived of their starch and soluble matter. Both samples in the table fully meet the guaranty of 24 per cent. protein and 7½ per cent. fat. A single sample bought of Gallagher Bros., Wallingford, by the Cook Farm, 18289, contained 28 per cent. of protein.

A sample, 18310, sent by P. A. Holt, Farmington, marked feed, consisted largely of oat and barley products, the latter from brewers' grains, and had the composition of dried brewers' grains as follows:

| | |
|---|---|
| Water | 9.57 |
| Ash | 5.35 |
| Protein | 25.56 |
| Fiber | 15.82 |
| Nitrogen-free Extract | 37.29 |
| Fat | 6.41 |
| | 100.00 |

## MISCELLANEOUS MIXED FEEDS.

### *Various Corn and Oat Feeds.*

Analyses on pages 212 to 215.

These are manufacturing wastes, sold under various proprietary names, some of them containing a considerable amount of hulls. The protein in them ranges from 7.62 to 10.75 and the woody fiber from 6.54 to 15.44. All of them are mixtures of corn and oat wastes, some with added hulls. 18060, Corn and Oat Chop, made by the Buffalo Cereal Co., and 18146, De Fi Corn and Oats, from Ellsworth & Co., Buffalo, also contain a wheat product. All of them have a guaranteed composition with which, in all cases, the analyses correspond. Their selling prices range from $22.50 to $26.00. The average, $24.20, is not much less than the price of wheat bran, which has nearly twice as much protein.

Certain corn and oat feeds, sent by individuals, were analyzed as follows:—

16137. Provender, made by Peterson & Hendee Co., Derby. No guaranty given. Cost $1.30 per bag.

18292. "Prepared Feed." Sold by A. D. Clark, Orange. Sampled and sent by W. H. Lee, Orange. It contained a wheat product, oats and corn.

ANALYSES.

| | 16137 Provender | 18292 Prepared Feed |
|---|---|---|
| Water | 8.73 | 10.64 |
| Ash | 3.02 | 4.27 |
| Protein | 11.00 | 10.75 |
| Fiber | 7.63 | 11.11 |
| Nitrogen-free Extract | 64.55 | 59.07 |
| Fat | 5.07 | 4.16 |
| | 100.00 | 100.00 |

A sample of "Corn and Oats, half and half," 16189, from S. E. Brown, Collinsville, contained 10.87 per cent. of protein and a sample of "mixed feed," 16087 from S. W. Eddy, Simsbury, which was a mixture of corn and oat products, contained 8.44 per cent. of protein and 14.09 of fiber. It cost $1.10 per hundred.

### *Wheat and Cobs.*

Analyses on pages 214 and 215.

Here are included a number of mixtures of wheat products and ground corn cobs sold under the name "mixed feed." "Mixed feed" has long been the name, recognized in the trade, of a mixture of bran and middlings from the flour mills. Its use applied to a mixture of wheat feed with the comparatively worthless cobs is clearly a deception unless the label discloses the real nature of the mixture. That cobs have a certain feeding value is generally admitted, but it is also universally known that this value is small as compared with bran or genuine mixed feed.

18019, Jersey Mixed Feed, C, was sold without tags or guaranty, in violation of law.

18087 and 18213, J. & F. Dairy Winter Mixed Feed, without guaranty or statement that they contained cobs, were also sold in violation of law.

Regarding one of these samples the dealers write: "We had paid sight draft on the car and as we did not know that it contained cobs we sold it, but no more of it for us."

Dealers and others are warned that the brands, Jersey Mixed Feed, J. & F. Dairy Winter Mixed Feed, and Lenox Mixed Feeds, are mixtures of wheat feed and ground corn cobs, and that their sale, without tags or labels setting forth these facts, with the guaranteed composition, is illegal.

The other samples of this material were marked to show that they contained cob meal.

### *Wheat and Corn Feed.*

Analysis on pages 214 and 215.

18223, Colonial Choice Middlings, made by Miner-Hillard Milling Co., is a mixture of wheat and corn products, the composition of which is well above the guaranty.

*Corn, Oats and Barley.*

Analyses on pages 214 and 215.

Schumacher's Stock Feed is a mixture of products from the three grains and agrees substantially in composition with its guaranty. Baringer's Corn, Oats and Barley, and that sold by F. A. Forbes of East Haven, were without the guaranty required by law.

A single sample, 16190, sent by S. E. Brown, Collinsville, from the Husted Milling Co., Buffalo, contained only 9.63 per cent. of protein.

*"Molasses Grains."*

Analyses on pages 214 and 215.

A single sample, 18306, sent by J. M. Gager, Willimantic, was marked Mueller's Molasses Grains.

It was stated by Mr. Gager that it was recommended as a dairy feed. It had been stored all summer and had heated somewhat, so that it was lumpy, and a bag marked 100 pounds weighed only 87. It had the following composition:

| | |
|---|---|
| Water | 14.37 |
| Ash | 6.95 |
| Protein | 18.37 |
| Fiber | 8.23 |
| Nitrogen-free Extract | 49.76 |
| Fat | 2.32 |
| | 100.00 |

A sample of feed, 18311, made by the New England Food Co. of South Norwalk, and sold for $20.00 per ton, sent by A. C. Innis, Ridgefield, contained

| | |
|---|---|
| Water | 8.25 |
| Ash | 1.42 |
| Protein | 12.69 |
| Fiber | 0.27 |
| Nitrogen-free Extract | 77.03 |
| Fat | 0.34 |
| | 100.00 |

It consists of biscuit or cracker crumbs, with rice and wheat flour.

## *Proprietary Horse Feeds.*

Analyses on pages 214 and 215.

Here are included analyses of six samples. All of them fulfil the guaranties given in each case, except Husted's Horse Feed, which contains but 10.87 per cent. protein where 12.0 is guaranteed.

*The American Cereal Co's. Horse Feed* contains cotton seed meal, wheat and corn products, oat product (hulls), weed seeds and molasses.

*Sucrene Horse Feed* contains malt sprouts, linseed, barley and corn products, oat products (with hulls), weed seeds and a sugar product.

*Buffalo Cereal Co's. Horse Feed* contains linseed meal, cracked corn and oat product (hulls).

*H. O. Horse Feed* and Husted's Horse Feed contain wheat product, cracked corn and chaffy oat product.

## *Proprietary Dairy and Stock Feeds.*

Analyses on pages 214 to 217.

Here are included a number of feeds apparently designed especially for cows in milk. All of them have a guaranty of composition.

The following fail to meet this guaranty:

| | Protein. | | Fat. | |
|---|---|---|---|---|
| | Found. | Guaranteed. | Found. | Guaranteed. |
| American Cereal Co.'s Dairy Feed..... | 12.50 | 14.0 | 3.55 | 3.5 |
| Buffalo Cereal Co.'s Dairy Feed ...... | 21.00 | 20.0 | 4.39 | 5.0 |
| Green Diamond Sugar Feed. Balanced ration .......................... | 12.75 | 16.5 | 2.03 | 3.5 |
| Lenox Stock Feed. Strong, Lefferts Co. | 8.62 | 9.8 | 3.75 | 3.2 |

The materials found in these dairy feeds are as follows:

*Molac Molasses Dairy Feed.* Cotton seed meal, wheat, oat and corn products (starch and bran), weed seeds (foxtail, bindweed, cockle, etc.), and molasses.

*Am. Cereal Co.'s Dairy Feed.* Wheat product, cracked corn and oat product (with hulls).

*Quaker Dairy Feed.* Cotton seed meal, wheat, corn and oat products, the latter with hulls.

*Biles' Union Grains, Ready Ration.* Cotton seed meal, linseed meal, malt sprouts, wheat product, corn product, and corn, oat and barley residues.

*Blatchford's Calf Meal.* Cotton seed, linseed, beans, wheat, fenugreek.

*Calf Laval Feed,* "the ideal feed to use with separator milk." Linseed meal, wheat and corn products.

*Buffalo Cereal Co.'s Creamery Feed.* Cotton seed meal, wheat, corn and chaffy oat products.

*Green Diamond Sugar Feed, balanced ration.* Malt sprouts, wheat product, oat product with hulls, rice hulls, weed seeds and molasses.

*H. O. Co.'s Milk Feed.* Wheat and corn products, barley and oat products with hulls.

*New England Stock Feed.* Cracked corn and oat product with hulls.

*Lenox Stock Feed.* Corn meal and a chaffy oat product.

A sample, 18299, of H. O. Co.'s Milk Feed, sent by F. S. Truesdell, Naugatuck; one of Sucrene Dairy Feed, 16390, sent by Meech & Stoddard, Middletown, and another of the same brand, 16359, sent by E. Manchester & Sons, Winsted, had the following composition:

| | H. O. Co.'s Milk Feed. | Sucrene Dairy Feed. 16390. | Sucrene Dairy Feed. 16359. |
|---|---|---|---|
| Water | 11.00 | 7.48 | 15.65 |
| Ash | 5.54 | 8.27 | 7.33 |
| Protein | 13.75 | 19.38 | 15.00 |
| Fiber | 12.11 | 8.70 | 9.02 |
| Nitrogen-free Extract | 53.30 | 52.84 | 50.10 |
| Fat | 4.30 | 3.33 | 2.90 |
| | 100.00 | 100.00 | 100.00 |

A sample of Hammond Dairy Feed sent by S. E. Brown, Collinsville, contained 17.50 per cent. of protein.

A sample of Bibbey's Dairy Cake, sent for examination from another station, contained carob-bean, cotton seed, wheat and maize products and fenugreek.

### *Proprietary Poultry Feeds.*

Analyses on pages 216 and 217.

*The American Cereal Co.'s Poultry Feed* contains cracked corn, a wheat product and a trace of oats.

*The Wyandotte brand, Boss Bros.*, contains cracked corn, millet, Kafir corn, or a related sorghum, wheat and charcoal.

*The Wonder Poultry Feed* contains wheat, corn and oat products and alfalfa.

*The H. O. Poultry Feed* contains rolled oats, cracked corn and wheat bran.

*Alfalfa Poultry Meal* contains alfalfa and corn meal.

A sample of Alfalfa Corn Meal, 16191, sent by S. E. Brown, Collinsville, from Husted Milling Co., Buffalo, contained 11.44 per cent. protein.

A sample of chicken feed sent by Mrs. J. H. Hopkins, Thomaston, suspected of being colored green with some dye, contained wheat screenings, cracked corn, millet, cracked green peas and oats. The green color was completely soluble in alcohol and the extract gave the absorption spectrum of chlorophyl. There is no evidence of the use of artificial color.

Alfalfa Meal, 18118, made by Flint Mill Co., Milwaukee, Wis., is misbranded. It is not alfalfa meal but a compounded feed containing alfalfa, cotton seed meal, malt sprouts, and wheat and oat products.

A sample of chicken wheat was sent us by a dealer with the question whether any of the seeds in it were likely to be injurious to poultry, or to introduce objectionable weeds on eastern farms. The question of the harmful quality of any of the seeds to poultry is one for poultry experts to determine. The botanical analysis of the sample is as follows:

| | Percentage by Weight. |
|---|---|
| Wheat | 91.12 |
| Oats | 4.13 |
| Ragweed | 1.90 |
| Vetch | 0.71 |
| Green and yellow foxtail grass | 0.65 |
| Barley | 0.36 |
| Mustard | 0.33 |
| Flax | 0.28 |
| Black bindweed | 0.13 |
| Cockle | 0.11 |
| Rape (?) | 0.10 |
| Chaff | 0.18 |
| | 100.00 |

### *Meat Scrap and Ground Bone.*

Analyses on pages 216 and 217.

These analyses show the usual, somewhat variable composition of meat scrap.

### *Condimental Cattle Foods.*

**16136**, Banner Stock Food, sent by E. J. Wallace, Wallingford, contained

| | |
|---|---|
| Water | 10.68 |
| Ash | 15.94 |
| Protein | 22.50 |
| Fiber | 20.78 |
| *Nitrogen-free Extract* | 24.72 |
| Fat | 5.38 |
| | 100.00 |

This mixture contains linseed meal, salt, Epsom salts, charcoal and fenugreek and possibly small quantities of other constituents.

In Meyer's Horse & Cattle Spice and also in his Poultry Spice sent from another station were found cotton seed meal, linseed meal, maize and wheat products, malt sprouts, cocoa shells, mustard seed, turmeric, and fenugreek.

## Silage and Corn for Silage.

The following analyses are of interest in this connection, although they do not represent commercial feeds.

16135 is Golden Leaming Corn as cut for silage. It was planted May 29-31, 1906, and cut Oct. 3, being rather dry and touched by frost. Rows 3½ feet apart, stalks about 9 inches apart in the row.

18301. Early Mastodon as cut for ensilage.

18305. Early Mastodon as cut for ensilage, from another field.

18300. Eureka Corn as cut for silage. The stalks lay cut for several days before being hauled to the barn.

16134. Eureka Corn as cut for silage in 1905, from the same field as 18300. All of the above are from Geo. A. Hopson, Wallingford.

18288. Ensilage from Eureka corn made in 1905, sampled September, 1906, by A. P. White, Winsted.

16364. Ensilage from E. Manchester & Sons, Winsted.

18724. Clover and oats ensilage from Thos. Holt, Southington.

| | Golden Leaming. | Early Mastodon. | | Eureka Corn. | | Ensilage. | | |
|---|---|---|---|---|---|---|---|---|
| | 16135 | 18301 | 18305 | 18300 | 16134 | 18288 | 16364 | 18724 |
| Water | 77.67 | 58.96 | 57.70 | 66.31 | 74.85 | 76.61 | 79.06 | |
| Ash | 1.14 | 1.71 | 1.64 | 1.40 | 1.03 | 1.38 | 1.31 | |
| Protein | 1.57 | 2.17 | 2.55 | 2.26 | 1.39 | 1.17 | 1.59 | 3.47 |
| Fiber | 6.87 | 10.36 | 10.16 | 9.34 | 7.79 | 8.68 | 7.45 | |
| N.-free Ext. | 12.39 | 25.92 | 26.90 | 20.07 | 14.58 | 11.85 | 10.21 | |
| Fat | 0.36 | 0.88 | 1.05 | 0.62 | 0.36 | 0.31 | 0.38 | 1.26 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | |
| *Calculated water-free.* | | | | | | | | |
| Ash | 5.11 | 4.17 | 3.87 | 4.15 | 4.11 | 5.91 | 6.26 | |
| Protein | 7.04 | 5.30 | 6.03 | 6.68 | 5.54 | 5.00 | 7.61 | 11.7 |
| Fiber | 30.77 | 25.21 | 24.01 | 27.71 | 30.90 | 37.11 | 35.61 | |
| N.-free Ext. | 55.45 | 63.16 | 63.60 | 59.63 | 58.02 | 50.71 | 48.71 | |
| Fat | 1.63 | 2.16 | 2.49 | 1.83 | 1.43 | 1.27 | 1.81 | 4.2 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | |

No fair comparison can be made of the different varieties of corn, as they were not grown on the same kind of land in the same year.

The samples of Early Mastodon were probably too dry when cut to make the best ensilage, owing to the impossibility of getting help at the right time. 18300 also was rather dry. The difference in water content of corn, when cut for ensilage, are instructive. One hundred tons, for example, of Eureka Corn, sample 16134, would contain about 25⅙ tons of water-free material, while 100 tons of sample 18300 would contain 33⅔ tons; of stated in another way 30 tons to the acre of 16134 would carry 15090 pounds of real feed, but a yield of 22⅖ tons of 18300 would carry as much.

*Gross yield with no statement of the per cent. of water in it, is no certain measure of real crop production. Water is not crop production.*

A drying wind at cutting time will reduce very considerably the gross yield, but does not of course affect the real food

value of the crop. When the corn is green or wet enough to pack perfectly in the silo, any additional water apparently only makes the crop more expensive to handle.

The clover and oats ensilage had a very strong odor, but we are informed is relished by cattle and, as the analysis shows, contains nearly twice as much protein as corn ensilage.

## THE DIGESTIBILITY OF FEEDING-STUFFS.

A certain part of every feeding-stuff is indigestible and passes through the body into the dung without doing anything to sustain the animal. The value of a commercial feed rests wholly in that portion of it which the animal can, under favorable conditions, digest or appropriate and make a part of itself. Some animals have greater power of digestion than others, and the amount of any ingredient, protein, fat, or fiber, digested by a given animal depends much on the proportion of other ingredients which are fed along with it. Thus, if starchy matter is fed in too large proportion, a considerable part of it will pass into the dung and be wasted. But fed in proper fashion over 90 per cent. of it may be taken up by the body and nourish it.

Table I gives the "digestion coefficients" of most of the feeds mentioned in Table IV.

The digestion coefficient of protein, for example, in cotton seed meal is 84. This means that in a properly made ration, neat cattle, in good health, may be expected, on the average, to digest about 84 parts out of every 100 parts of the protein of cotton seed meal of good quality. The table has no great mathematical precision, but is, nevertheless, a valuable general guide in feeding.

The use of the table is quite simple. Suppose analysis shows a certain sample of cotton seed meal to contain 43.5 per cent. of protein; that is, 43.5 pounds of protein in 100 pounds of the meal. It is desired to know how much *digestible* protein is contained in 100 pounds of meal. The table of "digestion coefficients" shows that of every 100 pounds of crude protein in cotton seed meal 84 pounds are digestible. It follows, by the rule of three (100 is to 84 as 43.5 is to 36.54), that, of the 43.5 pounds of protein, 36.54 pounds are digestible. To apply the table, multiply the percentage found on analysis by the proper

coefficient taken from the table and divide the product by 100. The result will be the percentage amount of *digestible* protein, fiber, etc., as the case may be.

In Table IV, under the averages of analyses, will be found calculated the average digestible nutrients contained in the different feeding-stuffs, so far as the data at hand permit.

TABLE I.—DIGESTION COEFFICIENTS, OR PERCENTAGES OF THE FOOD INGREDIENTS, FOUND BY ANALYSES, WHICH ARE DIGESTIBLE BY NEAT CATTLE.

(Lindsley's Compilation, Eighteenth Report Massachusetts (Hatch) Agricultural Station 1905, page 240 et seq.)

| | Protein. | Fiber. | Nitrogen-Free Extract. | Fat. |
|---|---|---|---|---|
| Cotton Seed Meal.......... | 84 | 35 | 78 | 94 |
| Linseed Meal, new process.. | 84 | 74 | 80 | 89 |
| Linseed Meal, old process... | 89 | 57 | 78 | 89 |
| Corn Meal ............... | 66 | .. | 92 | 91 |
| Hominy Meal .............. | 65 | 67 | 89 | 92 |
| Gluten Feed ............... | 85 | 76 | 89 | 83 |
| Wheat Bran ............... | 77 | 39 | 71 | 63 |
| Wheat Middlings .......... | 77 | 30 | 78 | 88 |
| Wheat Mixed Feed ........ | 78 | 62 | 77 | 87 |
| Rye Feed .................. | 80 | .. | 88 | 90 |
| Oats ...................... | 77 | 31 | 77 | 89 |
| Buckwheat Middlings ...... | 85 | 17 | 83 | 89 |
| Malt Sprouts .............. | 80 | 34 | 69 | 100 |
| Dried Distillers' Grains..... | 73 | 95 | 81 | 95 |
| Brewers' Grains ........... | 81 | 49 | 57 | 89 |
| Quaker Dairy Feed ........ | 70 | 55 | 59 | 74 |
| Corn and Oat Feed ........ | 71 | 48 | 83 | 87 |

## REGARDING THE PURCHASE OF COMMERCIAL FEEDING STUFFS.

A well-managed dairy farm should produce all of the coarse fodder,—in form of corn fodder or stover, hay and ensilage,—which is needed for the stock, and, excepting under unusual conditions, should also supply an abundance of starchy food, such as corn meal and in some cases oats and barley, for feeding purposes.

These the farmer should be able to produce in abundance.

But in order to feed them without waste and also to supply a deficiency in them, it is almost always advisable or necessary, in the absence of clover, alfalfa, or other leguminous crops, to buy feeds *rich in digestible protein*;—considerably richer in it than corn meal.

The analyses given on following pages show what feeds are at present on our market, which of them meet this demand for digestible protein at reasonable prices and which of them do not meet this demand and cannot be fed to advantage.

The main facts given in Table IV are summarized in Table II, which shows, first, the average composition of these feeding stuffs as determined by our recent examination and arranged according to the per cent. of protein in them; second, the amount of digestible matter in each feed, as far as we have been able to calculate it, and third, the average retail prices of the feeds in October and November last.

The table divides the commercial feeds into six classes.

I. Those containing over 30 per cent. of protein: Cotton seed, linseed, old and new processes, buckwheat middlings (a very concentrated, cheap feed), and continental gluten, which is not a true gluten but distillers' grains. These have an average content of protein of 34.10 and average cost $29.21.

II. Feeds containing between 30 and 25 per cent. of protein. Here belong distillery grains, dried brewers' grains and Globe and Buffalo gluten feed.

The average per cent. of protein in this group is 27.18 and average cost $27.08.

III. Feeds containing between 25 and 20 per cent. of protein: The other gluten feeds, malt sprouts, union grains, cotton seed feed, Buffalo creamery feed and calf laval feed. The average per cent. of protein is 22.57 and average cost $26.58.

IV. Feeds with between 20 and 15 per cent. of protein. Here belong all the wheat feeds, Sucrene horse feed, molasses dairy feed and rye feed, with an average protein content of 16.27 per cent. and average cost $24.86.

V. A large number of factory mixtures containing between 15 and 10 per cent. of protein, with an average of 12.25 per cent. The average cost is $25.08.

VI. A few feeds with less than 10 per cent of protein, averaging 9.09 per cent. and costing $24.92.

Study of these figures shows that feeds containing more than 16 per cent. of protein cost no more per ton than those containing little more than 9 per cent.

Feeds of the group which contains 27.18 per cent of protein cost only 50 cents a ton more than feeds of the group which contains only 22.57 per cent. of protein. If we reckon the nitrogen of protein at the same price as in commercial fertilizers, there should be a difference of about $2.60 per ton.

It is not difficult to select feeds selling at about the same price, one of which contains twice as much protein as the other.

In most cases a feeder cannot use to advantage any boughten feed containing less than 15 per cent. of protein.

Ready mixed feeds, made of a number of by-products or factory wastes, may wisely be let alone, unless the buyer can see for himself out of just what raw material the mixture is being prepared. Low grade, damaged corn, shriveled wheat, peanut refuse and wheat screenings containing many weed seeds, are not infrequently found in such feeds by careful examination, but are not easy for the buyer himself to recognize.

ABLE II.—AVERAGE COMPOSITION OF FEEDS IN CONNECTICUT MAR DIGESTIBLE MATTER IN THEM AND SELLING PRICE.

| | In 100 pounds of feed are contained pounds of | | | | | | In 100 pounds of feed are contained pounds of digestible | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Water. | Ash. | Protein. | Fiber. | Nitrogen-free Extract (Starch, etc.). | Ether Extract (fat). | Protein. | Fiber. | Nitrogen-free Extract. | Fat. |
| *ntaining over 30 per cent. protein.* | | | | | | | | | | |
| ton Seed Meal | 10.14 | 5.32 | 40.06 | 8.41 | 26.66 | 8.41 | 33.6 | 2.9 | 20.8 | 7.9 |
| seed Meal, new process | 11.22 | 6.21 | 35.46 | 9.05 | 35.87 | 2.19 | 29.9 | 6.7 | 28.7 | 2.0 |
| :kwheat Middlings | 12.99 | 4.84 | 32.75 | 7.02 | 34.26 | 8.14 | 27.8 | 1.2 | 28.4 | 7.2 |
| seed Meal, old process | 11.30 | 5.60 | 32.04 | 8.60 | 35.19 | 7.27 | 28.5 | 4.9 | 27.4 | 6.5 |
| itinental Gluten Feed | 6.70 | 3.71 | 30.19 | 9.14 | 37.27 | 12.99 | 22.3 | --- | 30.6 | 12.3 |
| *ontaining between 30 and 25 per cent. protein.* | | | | | | | | | | |
| ed Distillery Grains | 7.40 | 2.80 | 29.50 | 11.30 | 37.10 | 11.90 | 20.0 | --- | 30.4 | 11.3 |
| ten Feed, Globe | 9.08 | 3.02 | 27.47 | 6.95 | 50.09 | 3.39 | 23.3 | 5.3 | 44.6 | 2.8 |
| " " Buffalo Cereal Co. | 9.10 | 2.02 | 27.13 | 7.30 | 51.45 | 3.00 | 23.1 | 5.5 | 45.8 | 2.5 |
| ed Brewers' Grains | 9.31 | 3.89 | 26.68 | 13.98 | 38.72 | 7.42 | 21.6 | 6.9 | 17.1 | 6.6 |
| ten Feed, Buffalo | 10.10 | 2.26 | 25.14 | 6.61 | 52.90 | 2.99 | 21.4 | 5.0 | 47.1 | 2.5 |
| *ontaining between 25 and 20 per cent. protein.* | | | | | | | | | | |
| ten Feed, Warner's | 10.08 | 1.81 | 24.27 | 7.28 | 53.12 | 3.44 | 20.6 | 5.5 | 47.3 | 2.5 |
| " " Hubinger's | 10.16 | 1.12 | 23.87 | 7.22 | 54.20 | 3.43 | 20.3 | 5.5 | 48.2 | 2.5 |
| " " Piel's | 9.29 | 0.84 | 23.62 | 5.72 | 57.94 | 2.59 | 20.1 | 4.3 | 51.6 | 1.9 |
| " " Queen | 8.98 | 0.98 | 23.38 | 5.68 | 57.90 | 3.08 | 19.9 | 4.3 | 51.5 | 2.2 |
| on Grains | 9.42 | 5.11 | 23.44 | 9.62 | 45.08 | 1.33 | --- | --- | ---- | --- |
| t Sprouts | 10.47 | 5.47 | 22.84 | 11.96 | 47.67 | 1.59 | 18.3 | 4.1 | 32.9 | 1.6 |
| alo Creamery Feed | 9.38 | 4.67 | 21.00 | 11.64 | 48.92 | 4.39 | --- | --- | ---- | --- |
| Laval Feed | 11.25 | 4.25 | 20.37 | 6.75 | 47.53 | 9.85 | --- | --- | ---- | --- |
| on Seed Feed | 11.56 | 4.52 | 20.37 | 20.48 | 38.10 | 4.97 | --- | --- | ---- | --- |
| *ntaining between 20 and 15 per cent. protein.* | | | | | | | | | | |
| at Middlings, Spring | 11.70 | 4.56 | 17.56 | 6.60 | 54.32 | 5.26 | 13.5 | 2.0 | 42.4 | 4.6 |
| " Winter | 11.75 | 4.40 | 16.89 | 5.76 | 56.27 | 4.93 | 13.0 | 1.7 | 43.9 | 4.3 |
| ene Horse Feed | 11.11 | 6.27 | 16.50 | 8.45 | 53.93 | 3.74 | --- | --- | ---- | --- |
| at Mixed Feed, Spring | 11.59 | 5.25 | 16.36 | 7.83 | 54.06 | 4.91 | 12.8 | 4.8 | 41.6 | 4.3 |
| ac Molasses Dairy Feed | 11.24 | 5.46 | 16.25 | 11.70 | 51.95 | 3.40 | --- | --- | ---- | --- |
| at Mixed Feed, Winter | 11.44 | 5.77 | 16.07 | 7.47 | 54.49 | 4.76 | 12.5 | 4.6 | 41.3 | 3.9 |
| Feed | 12.60 | 3.86 | 16.06 | 4.33 | 59.93 | 3.22 | 12.8 | --- | 52.7 | 2.9 |
| at Bran, Winter | 11.48 | 6.87 | 15.46 | 9.09 | 52.67 | 4.43 | 11.9 | 3.5 | 37.4 | 2.8 |
| " Spring | 11.11 | 6.57 | 15.27 | 10.39 | 51.58 | 5.08 | 11.8 | 4.1 | 36.6 | 3.2 |
| *ntaining between 15 and 10 per cent. protein.* | | | | | | | | | | |
| ic Molasses Horse Feed | 11.24 | 5.70 | 14.06 | 12.89 | 53.06 | 3.05 | --- | --- | ---- | --- |
| se Feed, H.O. | 10.31 | 3.56 | 13.75 | 9.84 | 57.92 | 4.62 | --- | --- | ---- | --- |
| . Milk Feed | 10.02 | 4.70 | 13.75 | 12.50 | 54.98 | 4.05 | --- | --- | ---- | --- |
| at and Corn Feed | ---- | --- | ---- | ---- | ---- | ---- | --- | --- | ---- | --- |
| n Diamond Sugar Feed | 9.43 | 6.66 | 12.75 | 9.72 | 59.41 | 2.03 | --- | --- | ---- | --- |
| ker Dairy Feed | 10.20 | 5.24 | 12.50 | 13.87 | 54.64 | 3.55 | 8.8 | 7.6 | 32.2 | 2.0 |
| aloCerealCo's Horse Feed | 9.89 | 3.33 | 12.50 | 9.03 | 60.50 | 4.75 | --- | --- | ---- | --- |
| at and Corn Cob | 10.27 | 5.04 | 12.28 | 13.36 | 54.86 | 4.19 | --- | --- | ---- | --- |
| iny Feed | 10.16 | 2.86 | 11.02 | 4.90 | 62.28 | 8.78 | 7.2 | 3.3 | 55.5 | 8.1 |
| ı, Oats and Barley | 11.30 | 3.72 | 16.89 | 7.90 | 62.56 | 3.63 | --- | --- | ---- | --- |
| se Feed, Husted | 10.81 | 4.58 | 10.87 | 10.49 | 58.89 | 4.36 | --- | --- | ---- | --- |
| y Feed, Corn and Oats | 11.15 | 4.00 | 10.37 | 11.91 | 59.27 | 3.30 | --- | --- | ---- | --- |

## THE WEIGHT OF ONE QUART OF VARIOUS FEEDING STUFFS.

*The following table gives the weight of one quart of the feeds named, and is useful to calculate the weight of grain* ration fed, from the measure which is almost universally used on farms.

This table was prepared by Mr. H. G. Manchester, of Winsted.

TABLE III.—THE AVERAGE WEIGHT OF ONE QUART OF EACH OF THE FEEDS NAMED.

| | Pounds. |
|---|---|
| Cotton Seed Meal | 1.5 |
| Linseed Meal, old process | 1.1 |
| Linseed Meal, new process | 0.9 |
| Gluten Feed | 1.4 |
| Distillers' Grains | 0.7 |
| Wheat Bran, coarse | 0.5 |
| Wheat Middlings, coarse | 0.8 |
| Wheat Middlings, fine | 1.1 |
| Mixed Wheat Feed | 0.6 |
| Corn Meal | 1.5 |
| Hominy Meal | 1.3 |
| Provender | 1.5 |
| Oats | 1.2 |
| Rye Bran | 0.6 |
| H. O. Dairy Feed | 0.7 |
| Alfalfa Meal | 1.0 |
| Molasses or Sugar Feed | 1.1 |
| Victor Corn and Oat Feed | 0.7 |

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS

| | Brand. | Retail Dealer. |
|---|---|---|
| | OIL SEED PRODUCTS. | |
| | *Cotton Seed Meal.* | |
| 39 | Memphis Tenn. Mill, American Cotton Oil Co., N. Y. | *Willimantic:* The E. A. Buc |
| 57 | Owl Brand. F. W. Brode & Co., Memphis, Tenn. | *Norwalk:* The Holmes, K & Selleck Co. |
| 23 | Green Diamond Brand. Chapin & Co., Boston | *East Hartford:* W. J. Cox |
| 13 | " " " " St. Louis | *Colchester:* Colchester Gra Coal Co. |
| 16 | ........ J. E. Soper & Co., Boston | *Hartford:* Daniels Mill Co |
| 19 | Star Brand. J. T. & R. S. Wells, Memphis, Tenn. | *Norwich:* Norwich Grain C |
| | | Average of these 6 analyses |
| | | Average digestible |
| | *"Cotton Seed Feed."* | |
| 5 | Glenwood Brand. D. L. Marshall Co., Boston-New York | *New Britain:* C. W. Lines & |
| 1 | Glenwood Brand. D. L. Marshall Co., Boston-New York | *Hartford:* Daniels Mill Co. |
| | | Average of these 2 analyses |
| | *Linseed Meal, New Process.* | |
| 2 | Cleveland Flaxmeal. Amer. Linseed Co., Chicago | *Suffield:* Spencer Bros. |
| 7 | " " " " | *Guilford:* Morse & Landon |
| 1 | " " " " | *Stafford Springs:* G. L. De |
| 3 | Oil Meal. " " " | *New Haven:* R. G. Davis |
| 5 | " " " " | *Hartford:* The L. C. Da Grain Co. |
| 6* | New Process. " " " | *Boston:* C. M. Cox & Co. |
| | | Average of these 6 analyses |
| | | Average digestible |
| | *Linseed Meal, Old Process.* | |
| 1 | ........ American Linseed Co., N. Y. | *Waterbury:* The Platt Mill |
| 5 | ........ Metzger Seed & Oil Co., Toledo, Ohio | *New Haven:* Abner Hendee |
| 3 | " " " | *Hartford:* Smith, Northam & |
| | | Average of these 3 analyses |
| | | Average digestible |
| | *Entire Wheat.* | |
| 3 | Entire Wheat ground by Quinnebaug Mills, Danielson | Quinnebaug Mills |
| | WHEAT PRODUCTS. | |
| | *Bran from Winter Wheat.* | |
| 2 | ........ Wm. A. Coombs Milling Co., Coldwater, Mich. | *Plainville:* G. W. Eaton |
| 1 | (S) Canadian Bran. Chas. M. Cox Co., Boston†‡ | *Plainville:* G. W. Eaton |
| | Kemper Bran. Chas. M. Cox Co., Boston† | *New Britain:* C. W. Lines & |
| 5 | " " " " † | *Yantic:* A. R. Manning |
| 5 | Empress Bran. Larabee Co, Stafford, Kans. | *Guilford:* Morse & Landon |
| | ........ The Hunter Bros. Milling Co., St. Louis, Mo. | *New Haven:* Abner Hende |
| 7 | ........ National Milling Co., Toledo, Ohio† | *Yantic:* A. R. Manning |
| | Independence Bran. N. Y. City Milling Co. | *Bridgeport:* The W. M. Terr |
| | ........ The Northwestern Elev. & Mill Co | |

## SAMPLED IN 1906.

| Station No. | Analyses. | | | | | | P |
|---|---|---|---|---|---|---|---|
| | Water. | Ash. | Protein. | Fiber. | Nitrogen-free Extract. (Starch, gum, etc.) | Ether Extract. (Fat.) | |
| 239 | 9.60 | 7.40 | 41.00 | 6.53 | 26.07 | 9.40 | $3 |
| 167 | 11.14 | 6.29 | 39.25 | 7.82 | 26.05 | 9.45 | 3 |
| 123 | 10.90 | 5.55 | 36.25 | 11.23 | 29.46 | 6.61 | 3 |
| 243 | 9.10 | 5.95 | 41.37 | 7.94 | 27.42 | 8.22 | 3 |
| 106 | 9.85 | 6.80 | 42.00 | 6.61 | 25.45 | 9.29 | 3 |
| 199 | 10.26 | 5.90 | 40.50 | 10.31 | 25.52 | 7.51 | 3 |
| | **10.14** | **6.32** | **40.06** | **8.41** | **26.66** | **8.41** | **3** |
| | ---- | ---- | **33.6** | **2.9** | **20.8** | **7.9** | |
| 075 | 11.48 | 4.83 | 22.12 | 20.96 | 35.00 | 5.61 | 2 |
| 111 | 11.64 | 4.21 | 18.62 | 20.00 | 41.20 | 4.33 | 2 |
| | **11.56** | **4.52** | **20.37** | **20.48** | **38.10** | **4.97** | **2** |
| 172 | 11.21 | 5.64 | 35.62 | 9.09 | 36.31 | 2.13 | 3 |
| 187 | 11.62 | 5.73 | 36.00 | 9.55 | 34.90 | 2.20 | 3 |
| 241 | 11.13 | 6.31 | 35.62 | 8.92 | 35.84 | 2.18 | 3 |
| 033 | 11.13 | 5.70 | 35.44 | 8.81 | 36.52 | 2.40 | 3 |
| 105 | 12.13 | 5.62 | 35.25 | 8.86 | 36.06 | 2.08 | 3 |
| 356 | 10.10 | 8.26 | 34.81 | 9.10 | 35.58 | 2.15 | |
| | **11.22** | **6.21** | **35.46** | **9.05** | **35.87** | **2.19** | **3** |
| | ---- | ---- | **29.0** | **6.7** | **28.7** | **2.0** | |
| 221 | 10.45 | 5.17 | 35.87 | 8.27 | 34.07 | 6.17 | 3 |
| 026 | 11.45 | 5.86 | 30.12 | 8.70 | 35.58 | 8.29 | 3 |
| 113 | 11.99 | 5.77 | 30.12 | 8.83 | 35.95 | 7.34 | 3 |
| | **11.30** | **5.60** | **32.04** | **8.60** | **35.19** | **7.27** | **3** |
| | ---- | ---- | **28.5** | **4.9** | **27.4** | **6.5** | |
| 208 | 13.57 | 1.85 | 11.25 | 2.27 | 69.11 | 1.95 | |
| 082 | 11.71 | 6.39 | 14.00 | 9.22 | 54.15 | 4.53 | 2 |
| 083 | 11.74 | 7.73 | 15.37 | 9.46 | 51.68 | 4.02 | 2 |
| 076 | 11.53 | 6.94 | 16.25 | 9.36 | 50.99 | 4.93 | 2 |
| 196 | 11.05 | 6.44 | 15.50 | 8.67 | 53.49 | 4.85 | 2 |
| 186 | 11.13 | 7.82 | 15.87 | 10.10 | 51.21 | 3.87 | 2 |
| 027 | 11.82 | 6.98 | 15.75 | 7.57 | 53.13 | 4.75 | 2 |
| 197 | 10.84 | 7.11 | 16.25 | 9.00 | 52.40 | 4.40 | 2 |
| 147 | 12.52 | 6.40 | 15.87 | 9.98 | 50.83 | 4.40 | 2 |

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS

| BRAND. | RETAIL DEALER. |
|---|---|
| WHEAT PRODUCTS—*Continued.* | |
| *Bran from Winter Wheat.* | |
| K.C.K. Bran. The Southwestern Milling Co., Kansas City | *Hamden:* I. W. Beers |
| Choice. Voigt Milling Co., Grand Rapids, Mich. | *Hartford:* Smith, Northam & C |
| Canada Winter | *Hamden:* I. W Beers |
| | Average of these 12 analyses |
| | Average digestible |
| *Bran from Spring Wheat.* | |
| Banner Bran. Banner Milling Co., Buffalo, N.Y. | *New London:* Beebe & Bragaw |
| Choice Bran. Bay State Mill. Co., Winona, Minn. | *Meriden:* Meriden Grain & Fee Co. |
| [illegible]. G. Davis Co.'s Bran. Rochester, N. Y. | *Putnam:* F. M. Cole |
| Universal. Duluth Universal Mill Co., Duluth, Minn. | *New London:* Beebe & Bragaw |
| *Eaco Bran.* Everett, Aughenbaugh & Co., Waseca, Minn. | *New Haven:* Abner Hendee |
| Imperial. Imperial Milling Co., Duluth, Minn. | *Meriden:* A. H. Cashen |
| Elmco Fancy. Listman Milling Co., La Crosse, Wis. | *Hartford:* Daniels Mill Co. |
| ——— Missouri Valley Milling Co., Bismarck & Mandan, N. Dak. | *Meriden:* A. Grulich |
| Go-Far Bran. New Prague Flouring Mill Co., New Prague, Minn. | *New Haven:* J. T. Benham |
| ——— The Northwestern Consolidated Milling Co. | *New Haven:* J. T. Benham |
| Pillsbury Bran. Minneapolis | *Wallingford:* E. E. Hall |
| James Quirk Milling Co. Bran. Montgomery, Minn. | *Danielson:* Waldo Bros. |
| Ben Hur Coarse Bran. Royal Milling Co. | *Willimantic:* H. A. Bugbee |
| Fancy Bran. Geo. Tileston Milling Co., St. Cloud, Minn. | *Shelton:* Taylor & Morse |
| Coarse Bran. Washburn-Crosby Co., Washburn Mills | *Berlin:* Edward Slater |
| Black Hawk. Western Flour Mill Co. Davenport | *Branford:* S. V. Osborn |
| Snow's Flaky Bran. E. S. Woodworth & Co., Minneapolis, Minn. | *Norwich:* Chas. Slosburg |
| | Average of these 17 analyses |
| | Average digestible |
| *Middlings, Winter Wheat.* | |
| ——— Wm. A. Coombs Milling Co., Coldwater, Mich. | *Plainville:* G. W. Eaton |
| St. Louis. Chas. M. Cox Co., Boston, Mass.* | *New Haven:* J. T. Benham |
| [illegible] Middlings. Hecker-Jones-Jewell Milling Co., N. Y. | *New Haven:* Abner Hendee |
| [illegible] Middlings. Hecker-Jones-Jewell Milling Co., N. Y. | *Willimantic:* H. A. Bugbee |
| ——— The Hunter Bros. Milling Co., St. Louis | *Ansonia:* Ansonia Flour & Fee Co. |
| Extra White. Husted Milling Co., Buffalo, N. Y. | *New Canaan:* C. H. Fairty |
| ——— The Northwestern Elev. & Mill. Co., [illegible] | [illegible] |

## Sampled in 1906—*Continued.*

| Station No. | Analyses. | | | | | |
|---|---|---|---|---|---|---|
| | Water. | Ash. | Protein. | Fiber. | Nitrogen-free Extract. (Starch, gum, etc.) | Ether Extract. (Fat.) |
| 8043 | 11.08 | 6.10 | 15.12 | 9.96 | 53.80 | 3.94 |
| 8117 | 12.24 | 6.44 | 14.12 | 8.34 | 54.38 | 4.48 |
| 8044 | 11.04 | 7.40 | 15.37 | 8.65 | 52.85 | 4.69 |
| | **11.48** | **6.87** | **15.46** | **9.09** | **52.67** | **4.43** |
| | ---- | ---- | **11.9** | **3.05** | **37.4** | **2.0** |
| 8190 | 11.34 | 6.21 | 16.12 | 10.26 | 50.40 | 5.67 |
| 8052 | 10.77 | 7.02 | 15.12 | 11.13 | 51.06 | 4.90 |
| 8216 | 10.05 | 6.61 | 15.37 | 10.22 | 52.26 | 5.49 |
| 8192 | 11.39 | 6.45 | 15.12 | 11.19 | 50.70 | 5.15 |
| 8023 | 11.99 | 6.58 | 14.62 | 9.63 | 52.29 | 4.89 |
| 8058 | 11.60 | 6.03 | 16.25 | 9.51 | 51.65 | 4.96 |
| 8107 | 11.23 | 5.94 | 15.75 | 9.55 | 52.70 | 4.83 |
| 18062 | 11.50 | 6.83 | 15.25 | 9.74 | 51.52 | 5.16 |
| 18016 | 10.78 | 7.29 | 14.81 | 10.31 | 51.70 | 5.11 |
| 18015 | 11.05 | 6.42 | 15.12 | 9.62 | 52.96 | 4.83 |
| 18050 | 11.15 | 6.51 | 14.87 | 11.24 | 51.08 | 5.15 |
| 18212 | 9.59 | 6.47 | 15.00 | 11.72 | 52.04 | 5.18 |
| 18183 | 10.97 | 6.55 | 14.87 | 10.56 | 52.07 | 4.98 |
| 18139 | 11.60 | 6.49 | 15.50 | 10.02 | 51.59 | 4.80 |
| 18071 | 11.55 | 6.52 | 15.25 | 10.50 | 50.85 | 5.33 |
| 18069 | 11.42 | 7.17 | 15.25 | 10.67 | 50.61 | 4.88 |
| 18201 | 10.87 | 6.56 | 15.25 | 10.77 | 51.53 | 5.02 |
| | **11.11** | **6.57** | **15.27** | **10.39** | **51.58** | **5.08** |
| | ---- | ---- | **11.8** | **4.1** | **36.6** | **3.2** |
| 18081 | 12.55 | 4.30 | 15.00 | 5.26 | 58.24 | 4.65 |
| 18018 | 11.88 | 4.88 | 17.12 | 4.34 | 56.73 | 5.05 |
| 18024 | 11.41 | 5.57 | 16.50 | 9.02 | 51.98 | 5.52 |
| 18185 | 11.11 | 5.36 | 17.00 | 8.52 | 52.88 | 5.13 |
| 18132 | 12.07 | 3.91 | 16.25 | 4.10 | 58.62 | 5.05 |
| 18157 | 12.21 | 3.63 | 17.75 | 4.10 | 57.71 | 4.60 |
| | | | [illegible] | [illegible] | [illegible] | [illegible] |

## TABLE IV.—ANALYSES OF COMMERCIAL FEEDS

| | BRAND. | RETAIL DEALER. |
|---|---|---|
| | WHEAT PRODUCTS—*Continued.* *Middlings, Winter Wheat.* | |
| ɔ | Choice. Valley City Milling Co., Grand Rapids, Wis. | *Rockville:* Edward White |
| | | Average of these 10 analyse[s] |
| | | Average digestible |
| | *Middlings from Spring Wheat.* | |
| 3 | ........ Bay State Milling Co., Winona, Minn. | *Ansonia:* Ansonia Flour & Co. |
| 9 | Badger Standard. Berger, Crittenden Milling Co., Milwaukee, Wis. | *Hartford:* Smith, Northam & |
| 5 | Fancy White. Blaisdell Milling Co., Minneapolis | *Bethel:* Johnston & Morriso |
| 3 | Niagara White. Cataract City Mill Co., Niagara Falls, N. Y. | *New London:* Patty Schwar |
| 7 | Claro. Claro Milling Co., Lakeville, Minn. | *Derby:* Peterson, Hendee C |
| ) | Snow Ball. The Gardner Mill, Seymour Carter, Hastings, Minn. | *Bristol:* G. W. Eaton |
| 7 | <◇>. Imperial Milling Co., Duluth, Minn. | *Meriden:* A. H. Cashen |
| 1 | ........ W. J. Jennison Co., Minneapolis | *New London:* Beebe & Bra |
| 4 | ........ Northwestern Consolidated Milling Co., Minneapolis | *Meriden:* Meriden Grain & Co. |
| ) | A. Middlings. Pillsbury, Minneapolis | *Wallingford:* E. E. Hall |
| 3 | B. " " " | *Wallingford:* E. E. Hall |
| 3 | Daisy XX. " " | *New Britain:* M. D. Stanle |
| 2 | Standard. James Quirk Milling Co., Montgomery, Minn. | *Norwich:* Chas. Slosburg |
| 3 | Fancy. Geo. Tileston Milling Co., St. Cloud, Minn. | *Shelton:* Taylor & Morse |
| 5 | ........ Tennant & Hoyt, Lake City, Minn. | *Colchester:* Case Bros. |
| ) | Ben Hur. Royal Milling Co., Minneapolis | *Danielson:* Quinnebaug Mil |
| 3 | ........ Geo. Urban Milling Co., Buffalo, N.Y.* | *Putnam:* Bosworth Bros. |
| 3 | Standard, Washburn, Crosby Co., Washburn Mills | *Branford:* S. V. Osborn |
| 2 | Adrian. " " " " | *Berlin:* Edward Slater |
| ) | Flour Millings. Washburn, Crosby Co., Washburn Mills. | *So. Norwalk:* M. T. Hatch. |
| 7 | Middlings. N. Y. Milling Co., N. Y. | *Westville:* W. E. Warner & |
| | | Average of these 20 analyse[s] |
| | | Average digestible |
| | *Mixed Feed from Winter Wheat.* | |
| ɔ | Acme Feed. Acme Milling Co., Indianapolis, Ind. | *Hamden:* I. W. Beers |
| 1 | Buckeye Wheat Feed. American Cereal Co. | *Southington:* Southington ber & Feed Co. |
| 5 | Diamond Mixed Feed. Annan Berg & Co., St. Louis | *Hartford:* Smith, Northam & |
| 1 | Mixed Feed. Aug. J. Bulte Milling Co., Kansas City | *New London:* Patty Schwart |
| . | Winter Feed. Wm. A. Coombs Milling Co., Coldwater, Mich. | *Willimantic:* The E. A. Buck |
| · | Ozark. Chapin & Co., St. Louis | *Bristol:* G. W. Eaton |
| 1 | Garland. Garland Milling Co., Greensburgh, Ind. | *Suffield:* Arthur Sikes |
| : | ........ The Isaac Harter Mill. Co., Toledo, Ohio | *Bristol:* W. O. Goodsell |
| : | Manhattan. Hecker, Jones, Jewell Milling Co., N. Y. | *Hamden:* I. W. Beers |

## Sampled in 1906—*Continued*

| Station No. | Analyses. | | | | | | Pr p tc |
|---|---|---|---|---|---|---|---|
| | Water. | Ash. | Protein. | Fiber. | Nitrogen-free Extract. (Starch, gum, etc.) | Ether Extract. (Fat.) | |
| 180 | 11.54 | 4.38 | 15.75 | 5.26 | 58.31 | 4.76 | $26 |
| | **11.75** | **4.40** | **16.89** | **5.76** | **56.27** | **4.93** | **25** |
| | ---- | ---- | **13.0** | **1.7** | **43.9** | **4.3** | |
| 133 | 11.57 | 5.26 | 19.62 | 7.19 | 50.57 | 5.79 | 2. |
| 119 | 12.54 | 4.84 | 16.75 | 6.55 | 54.70 | 4.62 | 2 |
| 166 | 12.84 | 3.18 | 17.25 | 2.36 | 60.17 | 4.20 | 2 |
| 188 | 11.87 | 4.35 | 17.12 | 6.84 | 55.03 | 4.79 | 2 |
| 137 | 12.00 | 4.61 | 17.87 | 7.24 | 52.80 | 5.48 | 2 |
| 099 | 11.97 | 4.61 | 17.81 | 8.04 | 52.29 | 5.28 | 2 |
| 057 | 11.63 | 4.48 | 16.62 | 7.84 | 54.28 | 5.15 | 2 |
| 191 | 11.91 | 3.93 | 17.00 | 5.67 | 56.40 | 5.09 | 2 |
| 054 | 10.81 | 6.10 | 17.25 | 8.37 | 52.04 | 5.43 | 2 |
| 049 | 10.85 | 4.56 | 17.62 | 6.57 | 55.30 | 5.10 | 2 |
| 048 | 11.69 | 5.17 | 16.00 | 9.88 | 52.16 | 5.10 | 2 |
| 078 | 12.07 | 3.68 | 17.37 | 2.97 | 59.04 | 4.87 | 2 |
| 202 | 10.82 | 5.20 | 18.12 | 8.70 | 51.44 | 5.72 | 2 |
| 3143 | 12.03 | 4.53 | 18.87 | 5.69 | 52.83 | 6.05 | [illegible] |
| 3246 | 11.47 | 5.21 | 17.12 | 5.94 | 54.70 | 5.56 | [illegible] |
| 3210 | 11.38 | 4.72 | 17.25 | 8.10 | 53.55 | 5.00 | [illegible] |
| 3218 | 10.57 | 4.62 | 17.37 | 7.57 | 54.12 | 5.75 | [illegible] |
| 3068 | 11.60 | 4.66 | 18.00 | 8.13 | 52.06 | 5.55 | [illegible] |
| 3072 | 12.28 | 3.46 | 18.25 | 3.36 | 57.71 | 4.94 | [illegible] |
| 3159 | 12.24 | 3.90 | 17.44 | 5.37 | 55.83 | 5.22 | [illegible] |
| 3037 | 11.70 | 4.59 | 17.44 | 6.42 | 54.55 | 5.30 | [illegible] |
| | **11.70** | **4.56** | **17.56** | **6.60** | **54.32** | **5.26** | **2** |
| | ---- | ---- | **13.5** | **2.0** | **42.4** | **4.6** | |
| 3040 | 10.84 | 6.52 | 16.37 | 6.62 | 55.05 | 4.60 | |
| 3091 | 12.46 | 5.01 | 16.12 | 6.99 | 54.39 | 5.03 | |
| 3116 | 11.82 | 5.95 | 15.87 | 7.89 | 54.62 | 3.85 | |
| 3189 | 11.36 | 6.65 | 17.00 | 8.90 | 51.09 | 5.00 | |
| 3238 | 11.52 | 5.66 | 15.50 | 7.42 | 55.25 | 4.65 | |
| 3097 | 12.76 | 5.50 | 15.50 | 7.21 | 54.87 | 4.16 | |
| 3170 | 11.62 | 4.99 | 16.75 | 6.88 | 55.46 | 4.30 | |
| 3092 | 12.15 | 5.44 | 16.81 | 6.10 | 54.86 | 4.64 | |

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS

| BRAND. | RETAIL DEALER. |
|---|---|
| WHEAT PRODUCTS—*Concluded.* | |
| *Mixed Feed from Winter Wheat.* | |
| Queen. Hecker, Jones, Jewell Milling Co., N. Y. | *Willimantic:* H. A. Bugbee |
| Sunshine. Hunter Bros., St. Louis | *Meriden:* A. Grulich |
| ........ Kehlor Bros. | *New Haven:* R. G. Davis |
| Snowflake. Lawrenceburg Roller Mills Co., Lawrenceburg, Ind. | *New Britain:* C. W. Lines & ( |
| Sioux Fancy. Chas. R. Lull, Milwaukee, Wis. | *New Haven:* Wm. E. Warne Bro. |
| ........ National Milling Co., Toledo, Ohio.* | *Torrington:* E. H. Talcott |
| N. M. Co's. Mixed Feed. Nobleville, Ind. | *Berlin:* Edward Slater |
| ........ Rex Milling Co., Kansas City | *North Haven:* Co-operative F Co. |
| Samico. Saginaw Milling Co., Saginaw, Mich. | *Plainville:* F. B. Newton |
| *Romeo Winter Mixed Feed. J. E. Soper & Co.** | *Meriden:* A. Grulich |
| Try-me. Sparks Milling Co., Alton, Ill. | *New Haven:* Abner Hendee |
| Monarch Ground. F. W. Stock & Sons, Hillsdale, Mich. | *New Canaan:* C. H. Fairty |
| Farmer's Favorite Cow Feed. Valley City Milling Co., Grand Rapids, Wis. | *Rockville:* Edward White |
| | Average of these 22 analyses |
| | Average digestible |
| *Mixed Feed from Spring Wheat.* | |
| Royal. Brooks Elevator Co., Minneapolis | *Derby:* Peterson, Hendee Co |
| Fancy. A. H. Brown & Bro., Boston | *Suffield:* Spencer Bros. |
| Columbia Mixed Feed. Chas. M. Cox Co. | *Wallingford:* E. E. Hall |
| Wirthmore Wheat Feed. Chas. M. Cox Co., Boston | *New Britain:* M. D. Stanley. |
| <B> Huron Mixed Feed. Flint Mill Co., Milwaukee | *Colchester:* Colchester Grain Coal Co. |
| Boston Mixed Feed. Duluth Imperial Mill. Co., Duluth, Minn. | *New Haven:* Abner Hendee |
| ........ The Northwestern Consolidated Milling Co., Minneapolis | *Danbury:* C. W. Keeler |
| Pillsbury's Fancy Mixed Feed. Minneapolis | *Bristol:* W. O. Goodsell |
| "Regular" Wheat Feed. Henry Russell, Albany, N. Y. | *Yantic:* A. R. Manning |
| Occident. Russell, Miller Milling Co., North Dakota | *Meriden:* Meriden Grain & Fe Co. |
| Gold Mine Mixed. Sheffield King Milling Co., Minneapolis | *Plainville:* G. W. Eaton |
| ........ Thornton & Chester Milling Co., Buffalo, N. Y. | *Hartford:* Daniels Mill Co. |
| *Washburn, Crosby's Superior.* Washburn Mills | *Colchester:* Case Bros. |
| Snow's Mixed Feed. E. S. Woodworth & Co., Minneapolis | *Plainville:* G. W. Eaton |
| Sunbeam Mixed Feed. N. Y. Milling Co., N. Y. | *Plainville:* G. W. Eaton |
| | Average of these 15 analyses |
| | Average digestible |
| MAIZE PRODUCTS. | |
| *Corn Meal.* | |

SAMPLED IN 1906—*Continued.*

| Station No. | Analyses. | | | | | | Pri pe tor |
|---|---|---|---|---|---|---|---|
| | Water. | Ash. | Protein. | Fiber. | Nitrogen-free Extract. (Starch, gum, etc.) | Ether Extract. (Fat.) | |
| 84 | 11.14 | 6.02 | 16.25 | 9.41 | 52.41 | 4.77 | $24 |
| 64 | 11.59 | 6.06 | 15.75 | 6.52 | 55.04 | 5.04 | 24 |
| 30 | 11.06 | 5.77 | 15.37 | 8.00 | 55.04 | 4.76 | 24 |
| 73 | 10.91 | 5.29 | 15.94 | 7.77 | 55.64 | 4.45 | 26 |
| 36 | 11.68 | 5.58 | 15.62 | 6.80 | 55.50 | 4.82 | 24 |
| 25 | 10.09 | 5.51 | 17.25 | 7.40 | 55.18 | 4.57 | 25 |
| 70 | 11.55 | 5.24 | 16.12 | 6.09 | 56.16 | 4.84 | 26 |
| 31 | 11.68 | 6.14 | 15.62 | 8.16 | 54.06 | 4.34 | 2 |
| 79 | 11.56 | 5.50 | 14.25 | 8.63 | 55.42 | 4.64 | |
| 61 | 10.95 | 6.87 | 16.37 | 7.04 | 54.24 | 4.53 | 2 |
| 22 | 11.40 | 6.30 | 16.37 | 7.41 | 53.75 | 4.77 | 2 |
| 53 | 11.37 | 5.80 | 16.62 | 8.13 | 52.11 | 5.97 | 2 |
| 181 | 11.49 | 5.18 | 15.87 | 6.66 | 54.94 | 5.86 | 2 |
| | **11.44** | **5.77** | **16.07** | **7.47** | **54.49** | **4.76** | **2** |
| | ---- | ---- | **12.5** | **4.6** | **41.3** | **3.9** | |
| 138 | 11.93 | 5.10 | 18.12 | 7.93 | 52.07 | 4.85 | 2 |
| 173 | 10.51 | 6.11 | 16.62 | 9.48 | 51.48 | 5.80 | 2 |
| 045 | 11.09 | 5.30 | 16.00 | 8.49 | 53.78 | 5.34 | 2 |
| 077 | 11.85 | 5.08 | 16.00 | 8.14 | 54.43 | 4.50 | 2 |
| 244 | 11.28 | 4.17 | 15.00 | 6.27 | 59.57 | 3.71 | |
| 028 | 11.73 | 5.23 | 16.19 | 8.01 | 54.24 | 4.60 | 2 |
| 165 | 10.39 | 5.70 | 16.87 | 8.47 | 53.22 | 5.35 | 2 |
| 093 | 13.00 | 4.90 | 16.12 | 5.87 | 55.71 | 4.40 | 2 |
| 195 | 11.05 | 5.10 | 16.56 | 8.50 | 53.40 | 5.39 | 2 |
| 053 | 11.44 | 5.24 | 16.62 | 7.97 | 53.39 | 5.34 | 2 |
| 084 | 12.22 | 4.60 | 16.75 | 6.63 | 55.08 | 4.72 | 2 |
| 110 | 11.55 | 5.57 | 16.12 | 8.78 | 52.59 | 5.39 | 2 |
| 247 | 11.62 | 5.61 | 16.37 | 6.80 | 54.91 | 4.69 | 2 |
| 085 | 11.95 | 5.28 | 16.12 | 8.24 | 53.37 | 5.04 | 2 |
| 080 | 12.23 | 5.83 | 15.87 | 7.91 | 53.66 | 4.50 | 2 |
| | **11.59** | **5.25** | **16.36** | **7.83** | **54.06** | **4.91** | **2** |
| | ---- | ---- | **12.8** | **4.8** | **41.6** | **4.3** | |

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS

| BRAND. | RETAIL DEALER. |
|---|---|
| *MAIZE PRODUCTS—Continued.* | |
| *Corn Meal.* | |
| ........ Niagara Mill & Elev. Co., Buffalo, N.Y.* | *Hartford:* The L. C. Dan Grain Co. |
| ........ Spencer Bros., Suffield, Conn. | *Suffield:* Spencer Bros. |
| ........ Smith, Northam & Co., Hartford, Conn. | *East Hartford:* W. J. Cox |
| | Average of these 4 analyses |
| | Average digestible |
| *Gluten Feed.* | |
| Gluten Feed. Buffalo Cereal Co., Buffalo, N. Y. | *Stamford:* W. L. Crabb |
| " " " " " | *Thomaston:* L. E. Blackmer |
| | Guaranty |
| | Average of these 2 analyses |
| | Average digestible |
| Buffalo Gluten Feed. Corn Products M'f'g Co.† | *New Haven:* J. T. Benham |
| " " " " † | *New Haven:* R. G. Davis |
| " " " " † | *Westville:* Wm. E. Warner & E |
| " " " " † | *Wallingford:* E. E. Hall |
| " " " " † | *Plantsville:* T. B. Atwater |
| " " " " † | *Suffield:* Spencer Bros. |
| " " " " | *Branford:* S. V. Osborn |
| " " " " | *Hartford:* Smith, Northam & |
| " " " " | *So. Norwalk:* M. T. Hatch |
| | Guaranty |
| | Average of these 9 analyses |
| | Average digestible |
| Globe Gluten Feed. Corn Products Refining Co. N. Y. | *Clintonville:* S. A. Smith |
| " " " " | *North Haven:* Co-operative F Co. |
| " " " " | *Ansonia:* Ansonia Flour & F Co. |
| " " " " | *Middletown:* Meech & Stodd |
| " " " " | *Meriden:* Meriden Grain & F Co. |
| " " " " | *Bristol:* W. O. Goodsell |
| " " " " | *New Haven:* R. G. Davis |
| | Guaranty |
| | Average of these 7 analyses |
| | Average digestible |
| ........ J. C. Hubinger Bros. Co., Keokuk, Iowa | *New Haven:* Abner Hendee |
| ........ J. C. Hubinger Bros. Co., Keokuk, Iowa | *Derby:* Peterson-Hendee Co. |
| | Guaranty |
| | Average of these 2 analyses |
| | Average digestible |
| Queen Gluten. National Starch Co., New York. | *Willimantic:* W. D. Grant |
| " " " " | *Shelton:* Taylor & Morse |
| | Guaranty |

SAMPLED IN 1906—*Continued.*

| Station No. | Analyses. Water. | Ash. | Protein. | Fiber. | Nitrogen-free Extract. (Starch, gum, etc.) | Ether Extract. (Fat.) | P |
|---|---|---|---|---|---|---|---|
| 8104 | 13.39 | 1.51 | 8.87 | 1.76 | 70.87 | 3.60 | $: |
| 8176 | 13.24 | 1.40 | 8.87 | 1.81 | 70.79 | 3.89 | : |
| 8125 | 12.80 | 1.52 | 9.37 | 2.34 | 69.57 | 4.40 | : |
| | **13.34** | **1.42** | **9.06** | **2.04** | **70.21** | **3.93** | **2** |
| | ---- | ---- | **6.0** | ---- | **64.6** | **3.3** | |
| 8151 | 10.04 | 2.79 | 27.75 | 7.15 | 49.26 | 3.01 | : |
| 8224 | 8.17 | 1.24 | 26.50 | 7.46 | 53.64 | 2.99 | : |
| | ---- | ---- | **28.00** | ---- | ---- | **3.00** | |
| | **9.10** | **2.02** | **27.13** | **7.30** | **51.45** | **3.00** | **2** |
| | ---- | ---- | **23.1** | **5.5** | **45.8** | **2.5** | |
| 8017 | 9.35 | 1.96 | 24.50 | 6.72 | 53.08 | 4.39 | |
| 8034 | 10.12 | 2.21 | 24.50 | 6.21 | 54.37 | 2.59 | |
| 8038 | 9.13 | 3.07 | 25.12 | 7.02 | 52.71 | 2.95 | |
| 8047 | 10.35 | 2.18 | 25.00 | 6.37 | 53.20 | 2.90 | |
| 8088 | 11.57 | 1.36 | 25.75 | 6.21 | 52.79 | 2.32 | |
| 8175 | 9.07 | 3.05 | 27.37 | 6.92 | 50.32 | 3.27 | |
| 8067 | 9.78 | 2.56 | 25.75 | 6.99 | 51.58 | 3.34 | |
| 8115 | 11.03 | 2.22 | 23.87 | 6.27 | 54.24 | 2.37 | |
| 8160 | 10.48 | 1.80 | 24.37 | 6.79 | 53.76 | 2.80 | |
| | ---- | ---- | **24.00** | ---- | ---- | **2.50** | |
| | **10.10** | **2.26** | **25.14** | **6.61** | **52.90** | **2.99** | |
| | | ---- | **21.4** | **5.0** | **47.1** | **2.5** | |
| 18126 | 8.55 | 3.43 | 27.25 | 6.63 | 50.71 | 3.43 | |
| 18130 | 8.54 | 2.60 | 28.25 | 6.96 | 50.01 | 3.64 | |
| 18135 | 8.97 | 3.15 | 29.12 | 7.02 | 48.67 | 3.07 | |
| 18235 | 9.28 | 2.70 | 27.87 | 6.95 | 50.23 | 2.97 | |
| 18051 | 8.32 | 3.30 | 28.69 | 6.69 | 49.49 | 3.51 | |
| 18096 | 10.74 | 2.52 | 23.62 | 7.22 | 51.29 | 4.61 | |
| 18233 | 9.19 | 3.42 | 27.50 | 7.20 | 50.17 | 2.52 | |
| | ---- | ---- | **26.00** | ---- | ---- | **2.50** | |
| | **9.08** | **3.02** | **27.47** | **6.95** | **50.09** | **3.39** | |
| | ---- | ---- | **23.3** | **5.3** | **44.6** | **2.8** | |
| 18021 | 9.92 | 1.13 | 24.37 | 7.19 | 54.34 | 3.05 | |
| 18136 | 10.40 | 1.12 | 23.37 | 7.25 | 54.06 | 3.80 | |
| | ---- | ---- | **27.00** | ---- | ---- | **2.50** | |
| | **10.16** | **1.12** | **23.87** | **7.22** | **54.20** | **3.43** | |
| | ---- | ---- | **20.3** | **5.5** | **48.2** | **2.5** | |
| 18240 | 9.97 | 1.10 | 22.25 | 5.70 | 57.62 | 3.36 | |
| 18140 | 8.00 | 0.85 | 24.50 | 5.67 | 58.17 | 2.81 | |
| | | | ---- | | | **2.50** | |

## Table IV.—Analyses of Commercial Feeds

| Brand. | Retail Dealer. |
|---|---|
| Maize Products—*Continued.* | |
| *Gluten Feed.* | |
| ........ Piel Bros. Starch Co., Indianapolis, Ind. | *Hartford:* The L. C. Dan Grain Co. |
| | Guaranty |
| | Digestible |
| Warner's Gluten Feed. Corn Products Refining Co., N. Y.* | *East Haven:* F. A. Forbes |
| Warner's Gluten Feed. Corn Products Refining Co., N. Y. | *Plainville:* G. W. Eaton |
| Warner's Gluten Feed. Corn Products Refining Co., N. Y. | *Moosup:* T. E. Main & Sons |
| Warner's Gluten Feed. Corn Products Refining Co., N. Y. | *Manchester:* G. W. Kuhney |
| | Guaranty† |
| | Average of these 4 analyses |
| | Average digestible |
| *Hominy Feed.* | |
| ...... Allen Baker Commission Co., St. Louis* | *Plainville:* F. B. Newton |
| Hominy Feed. Buffalo Cereal Co., Buffalo, N. Y. | *Meriden:* A. H. Cashen |
| " " " " " | *Hartford:* Daniels Mill Co. |
| " " " " " | *Stamford:* W. L. Crabb |
| " " " " " ‡ | *Danielson:* Quinnebaug Mill |
| | Guaranty |
| | Average of these 4 analyses |
| | Average digestible |
| Hominy Feed. Chapin & Co., Boston‡ | *Danbury:* F. C. Benjamin & |
| Niagara. " " " ‡ | *New London:* Beebe & Brag |
| Green Diamond. " " " | *Moosup:* T. E. Main & Sons |
| Star Hominy. " " " ‡ | *Colchester:* Colchester Grain Coal Co. |
| Wirthmore Hominy. Chas. M. Cox Co., Boston‡ | *North Haven:* Co-operative F Co. |
| " " " " | *Rockville:* Rockville Mill Co. |
| " " " " | *Norwich:* Norwich Grain Co |
| | Guaranty |
| | Average of these 3 analyses |
| | Average digestible |
| ........ Husted Mill & Elev. Co., Buffalo, N. Y. | *Manchester:* G. W. Kuhney |
| ........ A. F. Lane, New York‡ | *Hamden:* I. W. Beers |
| Hominy Chop. Meech & Stoddard, Middletown, Conn.‡ | *Groton:* Groton Grain Co. |
| Hominy Feed. Miner, Hillard Mill. Co., Wilkesbarre, Pa. | *Meriden:* A. Grulich |
| Steam-Cooked Hominy Feed. Miner, Hillard Mill. Co., Wilkesbarre, Pa. | *So. Norwalk:* M. T. Hatch |
| Choice Steam-Cooked. Miner, Hillard Mill. Co., Wilkesbarre, Pa. | *Willimantic:* H. A. Bugbee |
| | Guaranty |
| | Average of these 3 analyses |

## Sampled in 1906—*Continued.*

| Station No. | Analyses. | | | | | | Pr p t |
|---|---|---|---|---|---|---|---|
| | Water. | Ash. | Protein. | Fiber. | Nitrogen-free Extract. (Starch, gum, etc.) | Ether Extract. (Fat.) | |
| 8102 | 9.29 | 0.84 | 23.62 | 5.72 | 57.94 | 2.59 | $2 |
| | | ---- | 27.00 | ---- | ---- | 2.60 | |
| | | ---- | 20.1 | 4.3 | 51.6 | 1.9 | |
| 8232 | 11.09 | 2.42 | 24.06 | 6.96 | 52.02 | 3.45 | 2 |
| 8079 | 10.35 | 1.81 | 24.75 | 7.21 | 52.43 | 3.45 | 2 |
| 8206 | 8.97 | 1.51 | 25.00 | 7.70 | 53.32 | 3.50 | 2 |
| 8178 | 9.92 | 1.50 | 23.25 | 7.25 | 54.73 | 3.35 | 2 |
| | ---- | ---- | 24.00 | ---- | ---- | 2.50 | |
| | 10.08 | 1.81 | 24.27 | 7.28 | 53.12 | 3.44 | 2 |
| | ---- | ---- | 20.6 | 5.5 | 47.3 | 2.5 | |
| 8101 | 10.62 | 3.00 | 10.62 | 4.69 | 61.41 | 9.66 | |
| 8059 | 10.27 | 2.78 | 10.75 | 4.04 | 63.51 | 8.65 | |
| 8108 | 11.19 | 2.56 | 10.37 | 4.00 | 63.96 | 7.92 | |
| 8150 | 11.54 | 2.46 | 10.62 | 3.87 | 63.50 | 8.01 | |
| 8211 | 10.01 | 2.55 | 10.87 | 4.64 | 63.94 | 7.99 | |
| | ---- | ---- | 10.25 | ---- | ---- | 8.00 | |
| | 10.75 | 2.59 | 10.65 | 4.14 | 63.73 | 8.14 | 2 |
| | ---- | ---- | 6.9 | 2.8 | 56.7 | 7.5 | |
| 8163 | 10.45 | 3.01 | 11.00 | 4.05 | 62.24 | 9.25 | |
| 8193 | 10.79 | 2.66 | 11.37 | 4.48 | 62.61 | 8.09 | |
| 8205 | 10.05 | 2.75 | 11.25 | 4.34 | 62.81 | 8.80 | |
| 8245 | 9.27 | 2.15 | 9.00 | 8.67 | 65.01 | 5.90 | |
| 8127 | 11.00 | 2.65 | 11.00 | 4.02 | 62.83 | 8.50 | |
| 8182 | 10.25 | 2.72 | 10.87 | 4.18 | 63.35 | 8.73 | |
| 8198 | 10.35 | 3.28 | 12.37 | 1.90 | 61.75 | 10.35 | |
| | ---- | ---- | 10.5 | ---- | ---- | 7.5 | |
| | 10.53 | 2.87 | 11.41 | 3.36 | 62.64 | 9.19 | |
| | ---- | ---- | 7.4 | 2.2 | 55.75 | 9.1 | |
| 8177 | 8.87 | 3.24 | 10.62 | 6.63 | 61.38 | 9.26 | |
| 8039 | 9.98 | 2.75 | 11.06 | 3.90 | 63.69 | 8.62 | |
| 8194 | 10.91 | 3.00 | 11.62 | 5.25 | 59.34 | 9.88 | |
| 8063 | 9.52 | 2.80 | 10.75 | 4.16 | 63.99 | 8.78 | |
| 8158 | 11.55 | 3.59 | 12.50 | 4.48 | 59.14 | 8.74 | |
| 8236 | 8.93 | 3.05 | 11.62 | 4.90 | 61.85 | 9.65 | |
| | ---- | ---- | 10.0 | ---- | --- | 7.5 | |
| | | | [illegible] | [illegible] | 61.66 | 9.06 | |

## TABLE IV.—ANALYSES OF COMMERCIAL FEEDS

| BRAND. | RETAIL DEALER. |
|---|---|
| MAIZE PRODUCTS—*Concluded.* *Hominy Feed.* | |
| ....... Wm. M. Payne & Son, New York.* | *New Haven:* R. G. Davis |
| ne Hominy. A. B. Porter & Co., Phila., Pa. | *East Hartford Meadow:* G. M. White |
| erling. M. G. Rankin & Co., Milwaukee | *East Hartford Meadow:* G. M. White |
| ....... J. E. Soper & Co., Boston | *Suffield:* Spencer Bros. |
| | Average of all (22) analyses |
| | Average digestible |
| ar Feed. Toledo Elevator Co., Toledo, Ohio | *Plantsville:* T. B. Atwater |
| " " " " | *Plainfield:* J. P. Kingsley & Son |
| " " " " | *Middletown:* Meech & Stoddard |
| | Guaranty |
| | Average of these 3 analyses |
| | Average digestible |
| RYE PRODUCTS. *Rye Feed.* | |
| 'e Feed. Birkett Mill Co., Penn Yan, N. Y.* | *Hartford:* Smith, Northam & Co. |
| " Abner Hendee, New Haven, Conn.* | *Southington:* Southington Lumber and Feed Co. |
| " Jennings & Fulton, Boston, Mass.* | *Willimantic:* H. A. Bugbee |
| " Chas. A. Krause Grain Co., Milwaukee, Wis.* | *Wallingford:* E. E. Hall |
| 'e Feed. New York City Milling Co., N. Y.* | *Bridgeport:* The W. M. Terry Co. |
| | Average of these 5 analyses |
| | Average digestible |
| OAT PRODUCTS. | |
| ound Oats. The W. M. Terry Co., Bridgeport, Conn. | *Bridgeport:* The W. M. Terry Co. |
| | Digestible |
| BUCKWHEAT PRODUCTS. | |
| *ckwheat Middlings. Quinnebaug Mills,* Danielson, Conn. | *Danielson:* Quinnebaug Mills |
| | Digestible |
| Buckwheat Feed" Russell & Berkett, Penn Yan, N. Y. | Sent by J. W. Porter, Hebron |
| BARLEY PRODUCTS. *Malt Sprouts.* | |
| ılt Sprouts. Atlantic Export Co., Milwaukee, Wis. | *New Haven:* R. G. Davis |
| rley Sprouts. Chase Grain Co., N. Y.* | *Danbury:* F. C. Benjamin & Co. |
| ılt Sprouts. Chas. M. Cox Co., Boston* | *New Britain:* C. W. Lines & Co. |
| rley Sprouts. Chas. M. Cox Co., Boston* | *North Haven:* Co-operative Feed Co. |
| | Average of these 4 analyses |
| | Average digestible |
| DISTILLERS' GRAINS. | |
| urex Grains. The J. W. Biles Co., Cincinnati, Ohio | *New Canaan:* C. H. Fairty |
| urex Grains. The J. W. Biles Co., Cincinnati, | |

## SAMPLED IN 1906—*Continued.*

| | Analyses. | | | | | | Pric per ton |
|---|---|---|---|---|---|---|---|
| | Water. | Ash. | Protein. | Fiber. | Nitrogen-free Extract. (Starch, gum, etc.) | Ether Extract. (Fat.) | |
| 35 | 8.82 | 2.55 | 10.87 | 3.97 | 65.94 | 7.85 | $24. |
| 29 | 8.55 | 3.54 | 11.75 | 4.77 | 60.47 | 10.92 | 27. |
| 27 | 9.68 | 3.38 | 10.25 | 6.50 | 60.43 | 9.76 | 27. |
| 74 | 10.86 | 2.61 | 11.12 | 4.50 | 62.71 | 8.20 | 26. |
| | **10.16** | **2.86** | **11.02** | **4.90** | **62.28** | **8.78** | **25.** |
| | ---- | ---- | **7.2** | **3.3** | **55.5** | **8.1** | |
| 86 | 11.29 | 2.67 | 9.25 | 8.08 | 61.92 | 6.79 | 25. |
| 03 | 8.45 | 3.15 | 9.50 | 10.50 | 61.49 | 6.91 | 24. |
| 19 | 8.11 | 3.09 | 9.12 | 10.09 | 62.93 | 6.66 | 24. |
| | ---- | ---- | **7.0** | ---- | ---- | **6.5** | |
| | **9.28** | **2.97** | **9.29** | **9.56** | **62.11** | **6.79** | **24.** |
| | ---- | ---- | **6.0** | **6.4** | **55.3** | **6.2** | |
| 14 | 12.86 | 3.74 | 16.25 | 3.77 | 60.09 | 3.29 | 26 |
| 90 | 13.13 | 3.88 | 15.56 | 4.65 | 59.69 | 3.09 | 28 |
| 37 | 12.70 | 3.95 | 15.00 | 4.75 | 60.55 | 3.05 | 24 |
| 46 | 11.92 | 4.08 | 17.12 | 4.42 | 58.99 | 3.47 | 23 |
| 48 | 12.40 | 3.66 | 16.37 | 4.07 | 60.33 | 3.17 | 24 |
| | **12.60** | **3.86** | **16.06** | **4.33** | **59.93** | **3.22** | **25** |
| | ---- | ---- | **12.8** | ---- | **52.7** | **2.9** | |
| 45 | 12.56 | 3.35 | 13.12 | 9.66 | 55.58 | 5.73 | 28 |
| | ---- | ---- | **10.1** | **3.0** | **42.8** | **5.1** | |
| 109 | 12.99 | 4.84 | 32.75 | 7.02 | 34.26 | 8.14 | 2 |
| | ---- | ---- | **27.8** | **1.2** | **28.4** | **7.2** | |
| 713 | 11.13 | 3.60 | 18.12 | 22.03 | 40.24 | 4.88 | |
| 032 | 9.90 | 5.45 | 20.56 | 12.65 | 49.75 | 1.69 | 2 |
| 162 | 10.58 | 5.48 | 24.62 | 11.35 | 46.60 | 1.37 | 2 |
| 074 | 10.75 | 5.55 | 23.44 | 11.80 | 46.81 | 1.65 | 2 |
| 129 | 10.64 | 5.40 | 22.75 | 12.04 | 47.54 | 1.63 | 2 |
| | **10.47** | **5.47** | **22.84** | **11.96** | **47.67** | **1.59** | **2** |
| | ---- | ---- | **18.3** | **4.1** | **32.9** | **1.59** | |
| 156 | 7.79 | 1.98 | 30.31 | 12.92 | 32.70 | 14.30 | 28 |

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS

| | BRAND. | RETAIL DEALER. |
|---|---|---|
| | DISTILLERS' GRAINS—*Concluded.* | |
| 8 | Ajax Flakes. Chapin & Co., Boston | *Bristol:* G. W. Eaton |
| 4 | Corn Protegran. Dewey Bros. Co., Blanchester, O. | *Middletown:* Meech & Stod |
| 7 | " " " " | Sent by E. Manchester & S Winsted |
| 0 | Continental Gluten Feed. Continental Cereal Co., Peoria, Ill.* | *Middletown:* Meech & Stod |
| 6 | Continental Gluten Feed. Continental Cereal Co., Peoria, Ill.* | *West Winsted:* E. Manches Sons |
| | | Guaranty |
| | | Average of these 2 analyses |
| | | Average digestible |
| | | Average composition of D lers' Grains |
| | | Average digestible |
| | BREWERS' GRAINS. | |
| 2 | Brewers' Grains. Anheuser-Busch Brewing Association, St. Louis, Mo. | *Shelton:* Taylor & Morse |
| 1 | Brewers' Grains. Anheuser-Busch Brewing Association, St. Louis, Mo. | *Suffield:* Arthur Sikes |
| | | Average of these 2 analyses |
| | | Average digestible |
| | MIXED FEEDS. *Corn and Oat Feeds.* | |
| ) | Victor Corn and Oat Feed. Quaker Oats Co., Chicago | *New Haven:* J. T. Benham |
| | | Guaranty |
| ) | Corn and Oat Feed. Quaker Oats Co., Chicago | *Hartford:* Daniels Mill Co. |
| | | Guaranty |
| | | Average of these 2 analyses |
| | | Average digestible |
| ) | Pearl Cooked Horse and Cow Feed. Flint Mill Co., Milwaukee, Wis. | *Norwich:* Chas. Slosburg |
| | | Guaranty |
| | | Digestible |
| | Boss Corn and Oat Feed. The Great Western Cereal Co., Chicago, Ill. | *New Haven:* Abner Hendee |
| | | Guaranty |
| | | Digestible |
| | Niagara Special. Niagara Mill & Elev. Co., Buffalo, N. Y. | *Hartford:* The L. C. Da Grain Co. |
| | | Guaranty |
| | | Digestible |
| | *Corn and Oat Chop.* | |
| | Corn and Oat Chop. Buffalo Cereal Co., Buffalo, N. Y. | *Meriden:* A. H. Cashen |
| | | Guaranty |
| | | Digestible |
| | Monarch Chop Feed. Husted Milling & Elev. Co., Buffalo, N. Y. | *Shelton:* Taylor & Morse |

SAMPLED IN 1906—*Continued.*

| Analyses. | | | | | | Price per ton. |
|---|---|---|---|---|---|---|
| Water. | Ash. | Protein. | Fiber. | Nitrogen-free Extract. (Starch, gum, etc.) | Ether Extract. (Fat.) | |
| 9.41 | 1.82 | 31.50 | 12.41 | 31.22 | 13.64 | $28.00 |
| 7.64 | 3.72 | 28.56 | 8.42 | 39.41 | 12.25 | 26.50 |
| 7.78 | 2.51 | 32.00 | 10.93 | 33.82 | 12.96 | |
| 7.47 | 3.05 | 30.75 | 8.96 | 36.79 | 12.98 | 26.50 |
| 5.93 | 4.37 | 29.62 | 9.32 | 37.77 | 12.99 | 26.00 |
| ---- | ---- | 33.00 | ---- | ---- | 14.00 | |
| 6.70 | 3.71 | 30.19 | 9.14 | 37.27 | 12.99 | 26.25 |
| ---- | ---- | 22.3 | ---- | 30.6 | 12.3 | |
| 7.4 | 2.8 | 29.5 | 11.3 | 37.1 | 11.9 | |
| ---- | ---- | 20.0 | ---- | 30.4 | 11.3 | |
| 9.36 | 3.92 | 28.62 | 13.01 | 37.46 | 7.63 | 27.50 |
| 9.25 | 3.86 | 24.75 | 14.96 | 39.98 | 7.20 | 24.00 |
| 9.31 | 3.89 | 26.68 | 13.98 | 38.72 | 7.42 | 26.75 |
| ---- | ---- | 21.6 | 6.9 | 17.1 | 6.6 | |
| 10.08 | 3.60 | 7.62 | 11.04 | 64.38 | 3.28 | 23.00 |
| ---- | ---- | 7.50 | ---- | ---- | 3.00 | |
| 11.50 | 2.72 | 8.00 | 10.72 | 63.72 | 3.34 | 25.00 |
| ---- | ---- | 7.50 | ---- | ---- | 3.00 | |
| 10.79 | 3.16 | 7.81 | 10.88 | 64.05 | 3.31 | 24.00 |
| ---- | ---- | 5.5 | 5.2 | 53.2 | 2.9 | |
| 9.93 | 3.66 | 10.75 | 7.83 | 60.43 | 7.40 | 25.00 |
| ---- | ---- | 10.00 | ---- | ---- | 6.00 | |
| ---- | ---- | 7.6 | 3.8 | 50.2 | 6.4 | |
| 11.28 | 3.15 | 8.87 | 6.54 | 65.88 | 4.28 | 22.50 |
| ---- | ---- | 8.50 | ---- | ---- | 3.50 | |
| ---- | ---- | 6.3 | 3.1 | 54.7 | 3.7 | |
| 11.35 | 3.72 | 8.87 | 12.62 | 58.03 | 5.41 | 26.00 |
| ---- | ---- | 8.31 | ---- | ---- | 3.83 | |
| ---- | ---- | 6.3 | 6.1 | 48.2 | 4.7 | |
| 10.18 | 4.06 | 8.50 | 12.55 | 60.52 | 4.19 | 24.00 |
| ---- | ---- | 7.50 | ---- | ---- | 3.50 | |
| ---- | ---- | 6.0 | 6.0 | 50.2 | 3.6 | |
| 12.26 | 2.72 | 7.75 | 9.80 | 63.82 | 3.65 | 24.00 |
| ---- | ---- | 7.50 | ---- | ---- | 3.50 | |

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS

| BRAND. | RETAIL DEALER. |
|---|---|
| MIXED FEEDS—*Continued.* | |
| *Corn and Oat Chop.* | |
| De Fi Corn and Oats. Ellsworth & Co., Buffalo | *Bridgeport:* The W. M. Terry |
| | Guaranty |
| | Digestible |
| | Average of all Corn and Oat Fe |
| | Digestible |
| *Wheat and Corn Cob Feeds.* | |
| Jersey Mixed Feed "C"* | *New Haven:* J. T. Benham |
| Jersey Mixed Feed. Indiana Milling Co., Terre Haute, Ind. | *New Haven:* Abner Hendee. |
| J. & F. Dairy Winter Mixed Feed | *Plantsville:* T. B. Atwater |
| " " | *Danielson:* Young Bros. Co. |
| | Average of these 2 analyses |
| Lenox Mixed Feed. Mfg. for T. E. Main & Sons | *Moosup:* T. E. Main & Sons. |
| | Guaranty |
| | Average of these 6 analyses |
| *Wheat and Corn Feed.* | |
| Colonial Choice Middlings. Miner, Hillard Milling Co., Wilkesbarre, Pa. | *Waterbury:* The Platt Mill C |
| | Guaranty |
| *Corn, Oats and Barley.* | |
| Schumacher's Stock Feed. Quaker Oats Co., Chicago | *Hamden:* I. W. Beers |
| | Guaranty |
| ........ M. F. Baringer, Phila., Pa. | *Colchester:* Colchester Grain Coal Co. |
| ........ F. A. Forbes, East Haven, Conn. | *East Haven:* F. A. Forbes |
| | Average of these 3 analyses |
| *Proprietary Horse Feeds.* | |
| Molac Molasses Horse Feed. Quaker Oats Co., Chicago | *Branford:* S. V. Osborn |
| Molac Molasses Horse Feed. Quaker Oats Co., Chicago | *Bristol:* W. O. Goodsell |
| | Average of these 2 analyses |
| | Guaranty |
| Sucrene Horse Feed. American Milling Co., Chicago | *Ansonia:* Ansonia Flour & F Co. |
| Horse Feed. Buffalo Cereal Co., Buffalo, N. Y. | *New Haven:* R. G. Davis |
| H-O. Co.'s Horse Feed. Buffalo, N. Y. | *Stamford:* Scofield & Miller. |
| Husted Horse Feed. Husted Milling Co., Buffalo, N. Y. | *New Canaan:* C. H. Fairty |
| | Guaranty |
| *Proprietary Dairy and Stock Feeds.* | |
| Molac Molasses Dairy Feed. Quaker Oats Co., Chicago | *Branford:* S. V. Osborn |
| Molac Molasses Dairy Feed. Quaker Oats Co., Chicago | *Bristol:* W. O. Goodsell |
| | Average of these 2 analyses |

## SAMPLED IN 1906—*Continued.*

| Station No. | Analyses. | | | | | | Pr p to |
|---|---|---|---|---|---|---|---|
| | Water. | Ash. | Protein. | Fiber. | Nitrogen-free Extract. (Starch, gum, etc.) | Ether Extract. (Fat.) | |
| 146 | 10.12 | 4.25 | 10.25 | 15.44 | 57.29 | 2.65 | $24 |
| | ---- | ---- | 8.30 | ---- | ---- | 3.00 | |
| | ---- | ---- | 7.3 | 7.4 | 47.6 | 2.3 | |
| | 10.81 | 3.48 | 8.83 | 10.82 | 61.78 | 4.28 | 24 |
| | ---- | ---- | 6.3 | 5.2 | 51.3 | 3.7 | |
| 019 | 9.72 | 5.86 | 11.56 | 14.22 | 55.19 | 3.45 | 22 |
| 029 | 10.95 | 5.04 | 12.00 | 13.75 | 54.88 | 3.38 | 23 |
| 087 | 11.14 | 6.11 | 11.62 | 15.20 | 52.33 | 3.60 | 22 |
| 213 | 9.58 | 5.15 | 12.50 | 15.06 | 54.07 | 3.64 | 23 |
| | 10.36 | 5.63 | 12.06 | 15.13 | 53.20 | 3.62 | 22 |
| 207 | 9.84 | 4.75 | 12.87 | 16.66 | 52.31 | 3.57 | 24 |
| | ---- | ---- | 12.1 | ---- | ---- | 3.2 | |
| | 10.27 | 5.04 | 12.28 | 13.36 | 54.86 | 4.19 | 23 |
| 223 | 10.40 | 3.35 | 13.12 | 5.25 | 60.40 | 7.48 | 27 |
| | ---- | ---- | 12.0 | ---- | ---- | 4.0 | |
| 041 | 9.71 | 4.00 | 10.75 | 11.58 | 59.48 | 4.48 | 2 |
| | ---- | ---- | 11.00 | ---- | ---- | 4.00 | |
| 242 | 11.53 | 4.80 | 11.44 | 7.35 | 62.62 | 2.26 | 2 |
| 230 | 12.66 | 2.36 | 10.50 | 4.78 | 65.54 | 4.16 | 2 |
| | 11.30 | 3.72 | 10.89 | 7.90 | 62.56 | 3.63 | 25 |
| 066 | 11.01 | 5.67 | 15.00 | 12.05 | 52.96 | 3.31 | 2 |
| 095 | 11.47 | 5.74 | 13.12 | 13.72 | 53.16 | 2.79 | 2 |
| | 11.24 | 5.70 | 14.06 | 12.89 | 53.06 | 3.05 | 24 |
| | ---- | ---- | 11.0 | ---- | ---- | 3.00 | |
| 134 | 11.11 | 6.27 | 16.50 | 8.45 | 53.93 | 3.74 | 2 |
| 031 | 9.89 | 3.33 | 12.50 | 9.03 | 60.50 | 4.75 | 2 |
| 149 | 10.31 | 3.56 | 13.75 | 9.84 | 57.92 | 4.62 | 2 |
| 154 | 10.81 | 4.58 | 10.87 | 10.49 | 58.89 | 4.36 | 2 |
| | ---- | ---- | 12.00 | ---- | ---- | 4.00 | |
| 065 | 11.30 | 5.49 | 16.25 | 11.10 | 52.48 | 3.38 | 2 |
| 094 | 11.17 | 5.45 | 16.25 | 12.31 | 51.41 | 3.41 | 2 |
| | 11.24 | 5.46 | 16.25 | 11.70 | 51.95 | 3.40 | 2 |
| | | | -- | | | 3.0 | |

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS

| Station No. | Brand. | Retail Dealer |
|---|---|---|
| | MIXED FEEDS—*Concluded.* | |
| | *Proprietary Dairy and Stock Feeds.* | |
| 18122 | Dairy Feed. White Corn and Oats. Quaker Oats Co., Chicago | *East Hartford:* W. J. |
| 18124 | Quaker Dairy Feed. Quaker Oats Co., Chicago | *East Hartford:* W. J. |
| 18222 | Calf Meal. Blatchford Calf Meal Factory, Waukegan, Ill. | *Waterbury:* The Platt |
| 18155 | Union Grains. Biles' Ready Rations. The J. W. Biles Co., Cincinnati, Ohio | *New Canaan:* C. H. F |
| 18121 | Calf Laval Feed. Flint Mill Co., Milwaukee, Wis. | *Hartford:* Smith, Nort |
| 18152 | Creamery Feed. Buffalo Cereal Co., Buffalo, N. Y. | *Stamford:* W. L. Crab<br>Guaranty |
| 18128 | Green Diamond and Sugar Feed. Chapin & Co., Buffalo, N. Y. | *North Haven:* Co-oper<br>Co. |
| 18100 | H.O. Milk Feed. The H. O. Co., Buffalo, N. Y. | *Plainville:* F. B. New |
| 18056 | New England Stock Feed, Buffalo, N. Y. | *Meriden:* Meriden Gra<br>Co. |
| 18161 | Lenox Stock Feed. The Strong, Lefferts Co., Springfield, Mass. | *Danbury:* F. C. Benja |
| | *Proprietary Poultry Feeds.* | |
| 18089 | American Poultry Feed. Quaker Oats Co., Chicago | *Southington:* Southingt<br>ber & Feed Co. |
| 18214 | Wyandotte Brand Boss Bros. Co., Worcester, Mass. | *Danielson:* Young Bro |
| 18120 | Wonder Poultry Feed. Flint Mill Co., Milwaukee, Wis. | *Hartford:* Smith, North |
| 18055 | H. O. Poultry Feed. Buffalo, N. Y. | *Meriden:* Meriden Gra<br>Co. |
| 18141 | Alfalfa Poultry Meal. Husted Milling & Elev. Co., Buffalo, N. Y. | *Shelton:* Taylor & Mor |
| 16360 | Alfalfa Poultry Meal. Husted Milling & Elev. Co.* | E. Manchester & Sons, |
| 18118 | Alfalfa Meal.† Flint Mill Co., Milwaukee | Smith, Northam & Co., |
| | MEAT SCRAP AND GROUND BONE. | |
| 18228 | Meat Scrap. Andrews & Spelman, Providence, R. I. | *East Hartford Meadow*<br>White<br>Guaranty |
| 18217 | Beef Scrap. J. C. Dow Co., Boston | *Putnam:* Bosworth Br<br>Guaranty |
| 18164 | Beef Scraps. Hinckley Rendering Co., Somerville, Mass. | *Danbury:* C. W. Keele<br>Guaranty |
| 18215 | Pure Bone & Meat Meal. Rogers Mfg. Co., Rockfall, Conn. | *Danielson:* Young Bro<br>Guaranty |

## SAMPLED IN 1906—*Concluded.*

| | Analyses. | | | | | | Pri pe to |
|---|---|---|---|---|---|---|---|
| | Water. | Ash. | Protein. | Fiber. | Nitrogen-free Extract. (Starch, gum, etc.) | Ether Extract. (Fat.) | |
| 22 | 11.15 | 4.00 | 10.37 | 11.91 | 59.27 | 3.30 | $25 |
| 24 | 10.20 | 5.24 | 12.50 | 13.87 | 54.64 | 3.55 | 25. |
| 22 | 11.05 | 4.98 | 27.25 | 5.85 | 46.18 | 4.69 | 70. |
| 55 | 9.42 | 5.11 | 23.44 | 9.62 | 45.08 | 7.33 | 28. |
| 21 | 11.25 | 4.25 | 20.37 | 6.75 | 47.53 | 9.85 | |
| 52 | 9.38 | 4.67 | 21.00 | 11.64 | 48.92 | 4.39 | 27. |
| | ---- | ---- | **20.00** | ---- | ---- | **5.00** | |
| 28 | 9.43 | 6.66 | 12.75 | 9.72 | 59.41 | 2.03 | 23. |
| 0 | 10.02 | 4.70 | 13.75 | 12.50 | 54.98 | 4.05 | 25. |
| 6 | 9.20 | 4.11 | 9.87 | 11.77 | 61.26 | 3.79 | 25. |
| 1 | 10.92 | 2.83 | 8.62 | 11.19 | 62.69 | 3.75 | 25. |
| 9 | 11.88 | 3.09 | 13.25 | 3.92 | 63.42 | 4.44 | 35. |
| 4 | 12.07 | 13.29 | 9.06 | 3.57 | 59.80 | 2.21 | 44. |
| 0 | 10.14 | 4.61 | 21.25 | 13.78 | 43.32 | 6.90 | |
| 5 | 10.33 | 3.92 | 17.25 | 5.66 | 57.16 | 5.68 | 34. |
| 1 | 11.84 | 4.97 | 12.75 | 13.79 | 53.60 | 3.05 | 30. |
| 0 | 11.76 | 4.51 | 11.62 | 13.88 | 54.61 | 3.62 | 27. |
| 8 | 10.79 | 6.55 | 20.00 | 16.37 | 42.51 | 3.78 | |
| 8 | 8.03 | 32.01 | 44.62 | ---- | 3.56 | 11.78 | 48. |
| | ---- | ---- | **25.00** | ---- | ---- | **10.00** | |
| 7 | 8.00 | 19.60 | 46.00 | ---- | 3.08 | 23.32 | 45. |
| | ---- | ---- | **50.00** | ---- | ---- | **16.0** | |
| 4 | 8.18 | 38.85 | 36.75 | ---- | 5.47 | 10.75 | 45. |
| | ---- | ---- | **40.00** | ---- | ---- | **10.0** | |
| 5 | 7.85 | 57.80 | 19.12 | ---- | 2.28 | 12.95 | 44. |
| | ---- | ---- | 35.40 | ---- | ---- | 13.0 | |

In conclusion, it is gratifying to note this year fewer glaring discrepancies than were formerly encountered between the manufacturers' guaranties and the actual composition of the feeds.

With few exceptions there is no evidence of any attempt on the part of manufacturers or dealers in feed to practice deception regarding the quality of the feed.

*There are, however, a good many feeds offered for sale, the* analyses of which appear in the table, which could not be sold to feeders who apply a fair knowledge of the art of feeding *stock and business methods to the buying of their feed.*

We have called attention in Part I of this report to the many very low grade fertilizers in the Connecticut market in which the buyer pays for plant food twice as much as he needs to pay for it, if he would study the composition and prices of what is in the market and make a wise, business-like selection.

The same thing is also true of the feeds in our market. *Cotton and linseed meals, the gluten and wheat feeds, distillery* and brewers grains and a few other standard things supply digestible protein at reasonable prices. They are all that any feeder needs to supplement and balance the hay, silage, stover and corn meal which his farm produces. They are the only commercial feeds which will supplement them. It is absolutely impossible to balance the feed which the farm produces with *boughten feed containing less than fifteen per cent. of protein,* which is more than many of these commercial feeds contain. On a well-managed farm there is no need to buy starchy feeds nor a single oat hull nor any chaff.

# PART IV.

## SIXTH REPORT

OF THE

# STATE ENTOMOLOGIST OF CONNECTICUT

*To the Director and Board of Control of the Connecticut Agricultural Experiment Station:*

In accordance with the provision made in Section 4387 of the General Statutes, I herewith transmit my sixth consecutive report as state entomologist. The financial statement corresponds with the State fiscal year ending September 30th, but otherwise the report covers the calendar year of 1906.

Respectfully submitted,

W. E. BRITTON,

*State Entomologist.*

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST FROM OCTOBER 1ST, 1905, TO SEPTEMBER 30TH, 1906.

*Receipts.*

| | |
|---|---|
| From E. H. Jenkins, Treasurer | $2,912.41 |
| Conn. Agr. Expt. Station, for assistance | 1.75 |
| Yale Forest School, insect cases | 2.50 |
| Various sources, for mileage | 6.18 |
| " " " stamps | .57 |
| Conn. Board of Agriculture, for gypsy moth work | 800.00 |
| | $3,723.41 |

*Expenditures.*

| | |
|---|---|
| Field, office and laboratory assistance | $1,283.53 |
| Printing and illustrations | 54.70 |
| Postage | 19.66 |
| Stationery | 53.90 |

| | | |
|---|---|---|
| Telephone and Telegraph | $ 4.33 | |
| Express, freight and cartage | 19.48 | |
| Library | 140.25 | |
| Laboratory apparatus and supplies | 164.04 | |
| Spraying apparatus and supplies | 21.64 | |
| Office supplies | 99.78 | |
| Traveling expenses | 290.26 | |
| Gypsy moth work | 1,553.31 | |
| Balance, cash on hand | 18.53 | |
| | | $3,723.41 |

*Memorandum*—This account of the state entomologist has been duly audited by the State Auditors of Public Accounts.

It has seemed best in the foregoing statement to place all expenditures incurred on account of the gypsy moth work under that head. A portion of this, of course, was for traveling expenses, for assistance and labor, for printing, for carting and for apparatus.

## Organization and Equipment.

The state entomologist has been assisted throughout the year, as in the past four years, by Mr. B. H. Walden, who has had charge of all work in the absence of the entomologist. Mr. Walden has done much of the field work, has had charge of the collection, and has done most of the photographic work. He has also aided in the preparation of this report. Miss Elizabeth B. Whittlesey has worked as stenographer for half of each day, as during last year.

On account of the gypsy moth work at Stonington, additional assistance became necessary and Mr. James A. Hyslop, a student in the Agricultural College at Amherst, Mass., had immediate supervision of the field work from July 1st to September 1st, and assisted one week in inspecting nurseries.

Messrs. J. H. Cleveland and Robert Carson of Stonington, C. H. Pangburn, D. B. Pangburn and P. L. Buttrick of New Haven, and G. R. J. Boggs of Cambridge, Mass., were employed at Stonington in banding trees and destroying caterpillars during the caterpillar season. D. B. Pangburn and Mr. Buttrick worked at the laboratory during August, the former on photographic work and the latter mounting insects and preparing life history sets for exhibition. Mr. G. H. Hollister, a graduate of the Connecticut Agricultural College at Storrs, began

work November 16th as foreman in charge of a gang of men at Stonington, cutting brush and scouting for egg-masses.

There has been no material change in equipment since my last report. Four metal cases and over one hundred Schmitt boxes have been purchased. The collection has been increased, especially by quite a lot of material captured at Stonington, this section of the state not being previously represented; and by about five hundred specimens, mostly moths, collected at Pemaquid Point, Maine, in August, by Prof. H. W. Foote of Yale University, and presented by him to the station.

Several books and separates have also been added to the department library.

### Publications from Entomological Department.

Bulletin No. 153. The Gypsy Moth and the Brown-Tail Moth, by W. E. Britton; 11 pages, 8 figures. Published in an edition of 10,000 copies and distributed in March.

Fifth Report of the State Entomologist (Part IV of the Station Report for 1905); 75 pages, 7 text-figures, xii plates. 9,000 copies, distributed in May.

Placard giving illustrations and brief description of the gypsy moth. 2,000 copies, May, distributed to schools and libraries.

San José Scale; Methods of Treatment in Connecticut. *National Nurseryman*, March, 1906.

Some New or Little-Known Aleyrodidae of Connecticut, II, by W. E. Britton. *Entomological News*, Vol. XVII, p. 127. 3 pages.

The Common House Fly in its Relation to the Public Health, by W. E. Britton. A paper read at a conference of health officers, New Haven, Dec. 8, 1905, and printed in the *Yale Medical Journal* for January, 1906.

"Tests of Lime-Sulphur Washes in Connecticut in 1905." "Destroying the Woolly Maple Leaf Scale by Spraying." Two short papers by W. E. Britton, read at the meeting of the Association of Economic Entomologists at New Orleans, Jan. 1st, 1906, and printed in the proceedings. Bulletin No. 60, Bureau of Entomology, U. S. Department of Agriculture.

Bulletin of Immediate Information No. 3. The Fumigation and Treatment of Nursery Stock, by W. E. Britton; 8 pages, 5 figures. Printed in an edition of 1,000 copies, and sent to nurserymen in November.

The Maple Leaf-Stem Borer or Sawfly (*Priophorus acericaulis* MacGillivray). A New Enemy of the Sugar Maple, by W. E. Britton. *Entomological News*, Vol. XVII, p. 313, November; 9 pages, 3 figures, 1 plate.

## Chief Lines of Work.

The general routine work of the office, such as inspecting the nurseries, examining orchards, gardens and greenhouses, identifying insects and answering letters, has taken more than the usual amount of time this season on account of the gypsy moth work, which has necessitated much correspondence, and induced people to send specimens. Then, too, the condition of the nurseries was such that considerably more time than usual was consumed in the inspection work.

Suppression work against the gypsy moth was carried on continuously from March until September, though men were not at work all of the time during May. The entomologist visited the infested region once and sometimes twice a week all summer to oversee the work, and Mr. Walden also made frequent trips to look after certain phases of it. This work altogether required more effort and attention than any other single line of work undertaken.

In combating the San José scale, over 600 apple, pear, peach and plum trees were sprayed, mostly with the lime and sulphur mixtures. "Scalecide" was given a trial, with satisfactory results. A few trees were sprayed with "Surekill," but it did not seem to be very effective as a scale destroyer.

The study of tobacco insects was continued, and a paper on this subject appears in this report.

Several experiments were conducted in dipping cabbage, cauliflower and other plants in arsenate of lead mixed in different proportions with water to prevent damage from maggot and cutworms. Some attention was also given to a study of insects attacking cucurbitaceous plants, which, with the cabbages, were grown on a piece of land at Mt. Carmel leased by the station for plant breeding work.

A few tests have been made of different gases for fumigating trees to kill the San José scale, but no report can be given at this time, and the work will be continued.

The study of the insect fauna of Connecticut has been continued, and several notable additions to the collection mark the season's work. Two papers on Orthoptera and Hymenoptera are now being prepared and will soon be published by the Geological and Natural History Survey.

The identity and life history of the maple leaf stem borer has been ascertained and is recorded in another part of this report.

## Exhibits.

Exhibits of injurious insects, their work, and the materials and apparatus for controlling them, were made at the annual meeting of the Connecticut Pomological Society at Hartford in February; at the fruit exhibition of the same society in connection with the Horseshoe Park Agricultural Association at its annual fair at Willimantic, September 18, 19 and 20; at Milford grange fair, October 10 and 11; and at the annual meeting of the State Board of Agriculture at New Haven, December 18, 19 and 20.

## Correspondence.

The work of the office during the year has necessitated the writing of 1,309 letters, and the sending of 172 circular letters and 381 packages by mail and express.

## Lectures.

The state entomologist has given seventeen addresses and lectures at farmers' institutes, grange meetings, village improvement and scientific societies during the year. Two of these were illustrated with lantern slides, and at nearly all of the others photographs and specimens were shown.

## Examination of Orchards and Gardens.

Thirty-four orchards, gardens and greenhouses have been examined for insect pests by the state entomologist or his assistants. In most cases the San José scale or the gypsy moth was feared.

## Inspection of Nurseries.

During the year forty nursery inspections have been made, and thirty-five certificates granted.

In form the certificate has not been changed, nor has there been any change in the law providing for the annual inspection of nurseries. In comparing the list of nurserymen receiv-

ing certificates with the list of 1905, we find about the same number of firms, though four names have been removed from the old list, and five new names appear in the list for 1906. Of those which have been removed from the list one nurseryman has gone out of business, and another has left the state, though his business will be continued by one of the firms new to the present list. Two firms have not been included in the list, and a third has not been given a certificate since the fall inspection, because they have not yet brought their nurseries into such a condition as to warrant the granting of certificates.

More time has been required to make these inspections than in previous years, owing partly to the fact that certain kinds of stock not previously found infested are now attacked by the scale. In making the fall inspections Messrs. Britton and Walden were busy most of the time during the months of September and October when weather permitted. The equivalent of one man working sixty-three entire days was the time actually consumed in making these inspections.

The nursery firms receiving certificates in 1906 were as follows:

LIST OF NURSERY FIRMS RECEIVING CERTIFICATES IN 1906.

| Name of Firm. | Location. | Inspection Finished. | Certificate Number. |
|---|---|---|---|
| Allen, Chas. I. | Terryville | Nov. 2, | 235 |
| Atwater, C. W. | Collinsville | Sept. 18, | 215 |
| Austin, Geo. W. | New Haven | Nov. 3, | 238 |
| Barnes Bros. Nursery Co. | Yalesville | Oct. 16, | 226 |
| Bowditch, J. H. | Pomfret Center | Sept. 10, | 212 |
| Brainard, Chester F. | Thompsonville | Oct. 8, | 221 |
| Bridgeport Nursery Co. | Bridgeport | Nov. 2, | 237 |
| Burr & Co., C. R. | Manchester | Oct. 8, | 220 |
| Comstock & Lyon | Norwalk | Oct. 29, | 233 |
| Conine Nursery Co., The F. E. | Stratford | Oct. 4, | 216 |
| Conn. Agricultural College | Storrs | Nov. 1, | 234 |
| Conway, W. B. | New Haven | Nov. 13, | 243 |
| Dehn & Bertolf | Greenwich | Oct. 18, | 228 |
| East Rock Park Nursery | New Haven | Nov. 7, | 240 |
| Elizabeth Park Nursery | Hartford | Dec. 31, | 244 |
| Elm City Nursery Co. | New Haven | Sept. 6, | 211 |
| Gurney & Co., H. H. | New Canaan | Oct. 4, | 218 |
| Hale, J. H. | So. Glastonbury | Nov. 6, | 239 |

| Name of Firm. | Location. | Inspection Finished. | Certificate Number. |
|---|---|---|---|
| Holcomb, Irving | Granby | Sept. 28, | 214 |
| Hoyt's Sons Co., Stephen | New Canaan | Oct. 5, | 219 |
| Hunt & Co., W. W. | Hartford | Oct. 8, | 222 |
| Jewell, Harvey | Cromwell | Oct. 9, | 225 |
| Kellner, H. H. | Danbury | Oct. 15, | 227 |
| Kelsey & Sons, David S. | West Hartford | Nov. 2, | 236 |
| Keney Park Nursery | Hartford | Dec. 31, | 245 |
| Norton, A. F. | New Britain | Oct. 17, | 229 |
| Oakland Nurseries | Manchester | Oct. 4, | 217 |
| Pierson, A. N. | Cromwell | Sept. 22, | 213 |
| Purinton, C. O. | Hartford | May 1, | 210 |
| Ryther, O. E. | Norwich | Oct. 27, | 232 |
| Scott, J. W. | Hartford | Oct. 23, | 230 |
| Sierman, C. H. | Hartford | Oct. 24, | 231 |
| Vidbourne & Co., J. | Hartford | Oct. 8, | 223 |
| Woodruff, C. V. | Orange | Nov. 8, | 241 |
| Woodruff & Sons, S. D. | Orange | Nov. 8, | 242 |

## Present Area of Connecticut Nurseries.

According to the statement of owners, supplemented in some cases by the estimate of the inspector, there are now 540 acres in Connecticut nurseries as against 422 acres in 1902.

With this increase in area there has been a change in the kind of stock grown: the tendency being to abandon the growing of fruit stock and increase the plantings of ornamental trees and shrubs, especially such as are not seriously injured by the San José scale.

## Condition of Nurseries in 1906.

I regret to state that we found the nurseries of the state more seriously infested with San José scale in the fall of 1906 than in any year since the annual inspection of nurseries began, in 1901. From what I can learn of the methods of nursery inspection as practiced in other states, I believe that on the whole our system is as thorough and as efficient as that of most other states. All fruit stock and all ornamentals liable to infestation are inspected in such a manner that every tree or shrub is seen by the inspector. If any are found infested, they are marked (trees by breaking, and shrubs with tags), and these are immediately removed from the nursery and destroyed.

*All other trees or shrubs in the row or block* are fumigated with hydrocyanic acid gas before being sold. Yet in spite of this system, which has been in use since 1901, and the inspection made more and more thorough each year, we found more scale than ever before.

This statement does not apply, however, to every nursery, for some owners have taken the matter in hand and have destroyed or treated their suspected stock, so that the spread of the scale has been checked. In such nurseries conditions have improved. There are even a few nurseries in which the scale was not found at all, nor has ever been found therein; but these are mostly small nurseries not handling fruit stock.

The chief trouble is that nurserymen do not give enough of their own attention to the matter. They rely too much on the work of the inspector, who has to examine a large area of nursery stock in a comparatively short time, and cannot therefore examine the individual trees or plants as thoroughly as he would need to in order to warrant the statement that they are absolutely free from scale. The certificates state that they are "apparently free."

Nurserymen are busy men. They have not found it convenient to take the time to inspect and treat their own stock. Some have great difficulty in obtaining help. Yet so far as the profits of their business are concerned, it would pay better to grow and handle less stock and take better care of it.

It is true that Connecticut is, and for a number of years has been, badly infested with San José scale, but while it may not be possible to grow nursery stock absolutely free from infestation, I am confident that the business can be handled so as not only to hold the scale in check, but to reduce the infestation so materially that the value of the stock destroyed each year will be insignificant. Nurserymen are too careless about propagating from infested trees. Cions, bud sticks and cuttings should all be taken from uninfested trees, even if it be necessary to fumigate growing trees and enclose them in gauze tents or cages to prevent reinfestation. At any rate, all propagating *wood should be fumigated with hydrocyanic acid gas to kill* any form of animal life which may be there, and no wood known to be infested should be used, even though fumigated.

## THE FUMIGATION AND TREATMENT OF NURSERY STOCK.*

There is a sentiment more or less prevalent among orchardists and nurserymen that stock is injured by fumigation with hydrocyanic acid gas, and some refuse to purchase stock which has been so treated, preferring to run the risk of obtaining scale-infested stock thereby. We cannot state that this sentiment is without foundation, because in many cases it is doubtless true that nursery stock has been injured by the treatment, but we have yet to learn of such injury where the work was properly and carefully done and where the stock was well ripened. At the meeting of the Official Horticultural Inspectors at Washington, D. C., November, 1905, the consensus of opinion was that no injury would result if the treatment was properly done. *Trees should not be fumigated when wet, and they should not be fumigated longer than the prescribed period,—half or three-quarters of an hour.*

If the gas is started generating at night and the house not opened until morning, or if the trees are wet when put into the house, we may expect injury. It is well known that a weaker dose for a longer time than is prescribed is both less fatal to the scale and more injurious to the trees. Some injury, especially bruising, results from the extra handling of the trees when fumigated, but it seems probable that injuries of other kinds, such as drying of the roots, or freezing, are often attributed to fumigation.

Since San José scale became such a pest in the eastern states it has been the custom of many official inspectors to advise or compel nurserymen to fumigate certain kinds of nursery stock before sending it out, especially if any infested trees have been found in or near it.

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* This paper was printed as Bulletin of Immediate Information No. 3 in a small edition of 1,000 copies, and sent to the nurserymen in November. It is here reproduced with slight changes.

## THE FUMIGATING HOUSE.

The house, if small, should be as nearly square as possible, with the generating basin at the bottom near the center, in order to insure the greatest possible uniformity in the distribution of the gas. The house should be gas-tight, with a door

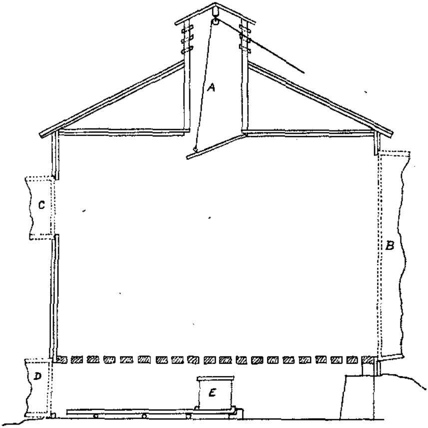


FIG. 1.—Diagram showing cross-section of a fumigating house 10 x 10 x 8 feet in size, with slat floor. A, ventilator that can be opened and closed from the outside; B, door where trees are carried in and out; C, small door opposite large one for ventilation; D, small door for *communicating with generator;* E, *jar for generating the gas.*

for transporting the stock, and adequate ventilators manipulated from the outside. A house ten feet square will be found adequate in most nurseries of not more than one hundred acres, and if not large enough, it will often be more convenient to have two of this size than one, larger. At any rate, a small house or box is absolutely necessary in any nursery to save the expense of chemicals in charging the large house when only a few trees or plants are to be treated.

A satisfactory house may be constructed of wood and double-boarded, with building paper between the boards. A slat floor raised a foot or more above the ground, with space for the generator beneath, ensures a more even distribution of the gas and also keeps the trees from contact with the moist earth. The accompanying diagram will give an idea of a good pattern of fumigating house.

Simple contrivances may be used for manipulating the ventilators from the outside and for removing the generating jar and replacing it, as well as for dropping the cyanide into it. All doors and ventilators should be arranged so that the house will be perfectly tight when closed.

## Directions for Fumigating.

The space to be fumigated should first be measured carefully, the quantities of chemicals computed, and the figures posted in some place convenient for ready reference. The cyanide for charging the generator a number of times can be weighed out in advance, each lot being placed in a paper or cheese cloth bag ready to be dropped, bag and all, into the acid, but these should be kept dry, in a tight tin box or glass jar, until wanted.

### *Formula.*

The following simple formula for preparing the gas was adopted by the Association of Official Horticultural Inspectors at a meeting in Washington in 1903:—

*Quantity for Each 100 Cubic Feet of Space—*

1 oz. (av.) Potassium cyanide 98-100% purity.
2 fluid ozs. High-grade sulphuric acid, 66° B. test.
4 " " Water.

A house 10 x 10 x 8 feet, such as is shown in the diagram, contains 800 cubic feet, and for each charge requires:—

½ lb. Potassium cyanide.
16 fluid ozs. (1 pint) Sulphuric acid.
32 " " (1 quart) Water.

**Caution! Potassium cyanide is one of the deadliest poisons. Do not let it come in contact with cuts or bruises, nor inhale the dust or fumes which rise from it when it is handled.**

### *Filling the House.*

The trees should be placed horizontally upon the slat floor with the roots outside and the tops meeting in the center over the generating jar. Trees or plants may be tied together loosely in bunches, but should not be packed in bales for shipping, as the packing may prevent the gas from reaching the insects, and thus render the operation valueless.

### *Generating the Gas.*

For a small house like that described, a single jar in the center will suffice. If much larger and square, four jars will insure a more even distribution of the gas. If the house is much longer than broad, it is well to have two jars, one under the center of each half of the house. Stone, glass, or earthenware should be used for generating jars. Metal is corroded by the acid, and wood is charred by it.

After the nursery stock has been placed in the house and the ventilators and doors closed, all is in readiness to generate the gas. The water should first be placed in the jar and the acid poured into it in a thin stream with constant stirring in order to prevent too rapid generation of heat. The jar should then be put in place and the cyanide dropped into it. The house should remain closed for at least thirty and not more than forty-five minutes. The overhead ventilator should first be opened, and then the side ventilator and the door. Care must be taken not to breathe the gas, which is one of the most deadly of poisons. The house should be aired for at least ten minutes before allowing any one to enter or remove the trees.

The liquid and residue from the generating jars is poisonous, and should be buried, and not left where children or domestic animals can get at it.

### *Chemicals.*

Much of the cyanide on the market contains, with other impurities, more or less sodium chloride, which decomposes a certain amount of the hydrocyanic acid gas, and is unsatisfactory for fumigating purposes. The Georgia State Board of Entomology collected a number of different brands of cyanide from various dealers and had them analyzed. Only

two brands were sufficiently pure to be reliable for fumigating nursery stock, and nurserymen were recommended to buy these brands, which are—

Merck & Co.'s "98-100%" potassium cyanide.
Baker & Adamson Chem. Co.'s "99%" potassium cyanide.

Both kinds are prepared for chemical use, and may be ordered in advance from any wholesale druggist or dealer in chemicals. The nurserymen should insist on getting one of these brands in the *original sealed packages,* and not be supplied with something else "just as good." The Station has just purchased a five pound package of Merck's cyanide at 35 cents per pound.

A high grade commercial sulphuric acid (66° B.) should be employed. In the large nurseries it will pay to buy acid in carboys, but small quantities can be had in bottles.

## Fumigate Buds, Cions and Cuttings.

The most serious source of infestation of growing nursery stock is through the buds, cions or cuttings. If slightly infested when set, the scales multiply sufficiently to mark the stock by the time it is inspected, or is large enough for sale, consequently much of it must be destroyed on account of scale. Where the scale is introduced on buds, cions or cuttings, the lower portion of the trunk is the first to show the infestation, but if brought by animals, the scale is usually found in the tops of the trees. If allowed to remain untreated in either case, the tree soon becomes coated. All buds, cions and cuttings should therefore be fumigated thoroughly before setting. A small box can be used, and the cost of materials will be much less than if the large fumigating house is charged.

## Treatment of Growing Stock.

The foregoing directions are applicable only to such nursery stock as may be dug for sale or shipment. Of course, much of the stock cannot be so treated, because it is too small for sale, and if dug and replanted its growth will be greatly checked. Though possible to fumigate growing stock by covering it with gas-tight canvas, the expense is too great,

and spraying must be relied upon to destroy any scale that may be on the trees. Official inspection as commonly practiced is sufficient to detect the infestation unless it be extremely slight, but it is practically impossible on account of the time and expense involved to examine the stock with such care that an absolute statement can be made that it is not infested. Too many nurserymen rely solely upon the official inspector for detecting the scale, and give no inspection themselves or treatment to hold the scale in check, if it be present. It often happens that a few specimens of scale may be overlooked during the annual September inspection or perhaps may be brought to the trees after the inspection. These will multiply until December, and go on spreading the next season, becoming badly covered by fall; and from this source birds, insects or other agencies carry the pest to surrounding stock, necessitating the destruction of a large quantity of it. The scale breeds from June 25th to December 1st in Connecticut, and during this time anything coming in contact with the bark of an infested tree is liable to carry away some of the new-born scales. From a badly infested tree the scales are certain to be distributed along the row by the men and horses in cultivating the field. The owner should inspect his own stock each year not later than July 1st. One tree destroyed then may save a dozen later in the season. The workmen should be familiar with the pest, and whenever an infested tree is discovered it should be taken out.

## Spray Growing Nursery Trees.

Even though we guard against the introduction of the scale by means of buds and cions, it may be brought to the trees by birds and insects during the growing season, especially if in a region where scale is common and the environs are not under direct control of the nurseryman. By spraying the young trees, during the winter or while dormant, with the lime and sulphur wash, "Scalecide," or some other "soluble oil," it is possible to keep the pest in check. "Scalecide" has given satisfactory results, and on account of ease of preparation it is preferable to lime and sulphur. It is especially adapted to nursery purposes, as it leaves no white coating on the trees.

It forms no spots on painted buildings or fences, and is not unpleasant to handle. On the other hand, lime and sulphur possesses fungicidal properties not found in the "soluble oils."

The cost of this spraying should not be more than fifteen or twenty dollars per acre, and the work probably can best be done by men working separately, each fitted with a knapsack sprayer. The spraying should be done when there is no snow on the ground and on a still day.

## ENTOMOLOGICAL FEATURES OF 1906.

The very mild winter of 1905-6 seemed especially favorable to most forms of insect life. A smaller percentage than usual of the San José scale was killed by the winter, and hence the pest has spread with greater rapidity than usual through the season.

The maple leaf stem borer, which has been the subject of study for several years, proved to be a sawfly, and adults were secured for the first time in 1906. This interesting insect is not yet to be considered as an important pest, yet it is spreading, and in certain places and under certain conditions is capable of doing much harm. An article on p. 295 gives a brief account of it.

The most important feature of the season was the discovery of the gypsy moth at Stonington. A female moth was captured in 1905 by Mr. Frensch, who put it in his collection and forgot about it, but finally reported it to the state entomologist in February, 1906, after receiving a request for records of rare captures. A more complete account of this discovery was given in the Report for 1905, p. 246.

The warning regarding this insect was sent out in Bulletin No. 153, and was printed in newspapers throughout the state. Consequently people were watching for this pest, and observed other kinds of insects. Many caterpillars were received from persons who were anxious to learn if they were the gypsy caterpillars. As yet we have no record of the presence of the brown-tail moth in Connecticut. The spiny elm caterpillar (*Euvanessa antiopa* Linn.) was very common, and was sent to the station twenty-six times, from all parts of the state, and in many cases this species was mistaken for the gypsy caterpillar.

The spiny elm caterpillar is the subject of a separate article on p. 260 of this report.

As in 1905, much damage was caused by cutworms in gardens and fields. Potato beetles were more abundant in most parts of the state than for three years. Aphids were abundant and injurious. The apple aphis (*Aphis pomi* DeG.) did much damage in some of the nurseries and newly-set orchards. In several nurseries it was necessary to dip the upper twigs into kerosene emulsion or soap and water to kill the aphids, so that growth would not be too greatly checked.

In August Mr. Walden visited a large seed storehouse in Milford and found the grain infested by an insect not commonly found in such places, though its work is very similar to that of the Indian meal moth described in the Report for 1905. Specimens were sent to the Bureau of Entomology of the U. S. Department of Agriculture at Washington, and it was identified as the European grain moth, *Tinea granella* L. This is the first record of this insect for Connecticut, and Dr. Howard writes that the same species had been received from Canada and from Michigan during the year. Previous to this it was not known with certainty to occur in America.

During the winter my attention was called by Prof. L. V. Pirsson of the Sheffield Scientific School of Yale University to an infestation of Kirtland Hall by the "powderpost" beetle (*Lyctus unipunctatus* Hbst. = *striatus*). The building was finished in ash, and had been occupied only about a year. Many of the casings, shelves, drawers, desks and cabinets were infested, some pieces of wood being drilled full of holes. Sap wood was used somewhat in finishing the building, and this was the worst infested. Benzine was suggested as a remedy, and I afterward learned that it had been used with good results.

In late summer the leaves of chestnut trees turned brown from the attacks of a mite, closely allied to the red spider. Egg-shells were present in large numbers, and in some cases the mites were crawling about. The species was identified by Mr. Nathan Banks as *Tetranychus bicolor* Banks.

The season was also remarkable on account of the unusual prevalence of the apple leaf miner, *Tischeria malifoliella* Clem., in certain parts of the state, where it did considerable damage.

The species occurs every year, but has not hitherto been regarded as serious. It was so abundant and injurious in the vicinity of the agricultural college at Storrs that a bulletin was issued regarding it.

The eggs of the white-marked tussock moth (*Hemerocampa leucostigma* S. & A.) have been sent in by many correspondents, who mistook them for gypsy moth eggs. They were very common in Stonington and other portions of the state. A few eggs of the rusty tussock moth (*H. antiqua* Linn.) were received, but judging from the eggs received and observed, this species is much less common here than in northern New England, where it is one of the commonest species.

In June Mr. Walden found in a peach orchard a sawfly, being a new species of the family Lydidae, laying eggs on the leaves, which were afterward devoured by the larvae.

## GYPSY MOTH WORK IN CONNECTICUT.

The occurrence of this insect within the State was not known to me until March, 1906. The report for 1905 being still unprinted, an illustrated account of the gypsy moth and of its discovery in Stonington was given on pages 246 to 254 of that report, as well as in Bulletin No. 153.

The work of fighting the insect was begun the day that its presence in Connecticut was established. As the eggs commence to hatch about May 1st, it was imperative that immediate action be taken to prevent the spread of this pest and to wipe it out if possible. We secured from the Massachusetts authorities, through the kindness of the Superintendent of Gypsy Moth work, Mr. A. H. Kirkland, the services of a trained inspector or scout, Mr. C. S. Mixter, who on March 20th began his examination of the infested region. Mr. Mixter inspected the trees in the village, as far as Wequetequock on the highway to Rhode Island, about as far north as the Hull estate, and as far west as Quambog Cove, covering an area of about five square miles. Egg-masses were found around the velvet mill and north and west of it, and one egg-mass was found in the apple orchard across the street in front of the school house. About thirty egg-masses were found and destroyed before the

time for hatching, and it was supposed that nearly all had been gathered. Several were found on the low bushes around Elihu's Pond near the velvet mill, which were cut over an area of about five acres, and burned April 26th, before the eggs hatched.

Though Mr. Mixter's examination fixed the approximate limits of the infested area, the time that he could be spared from his work in Massachusetts was too short to make a thorough search in obscure places. Hence a number of egg-masses were overlooked, hatched, and were found one by one during the work of banding trees and destroying caterpillars in June and July. In all thirty-six egg-masses were discovered which had hatched out after it was thought that all had been destroyed. This state of affairs made the work much more complicated than if these egg-masses had been found and destroyed previous to the time of hatching.

The method was adopted here which has proved so effective in Massachusetts,—trapping the caterpillars under burlap bands. Though the first bands were placed on trees about the middle of May, few caterpillars were found under them until about the first of June. Up to this time the work had been managed from the office in New Haven, and no one connected with it had resided in Stonington. Several trips to Stonington were made for the purpose of examining the bands, but it soon became evident that it was necessary to have some one employed constantly on the work in order to ascertain the exact conditions existing in the infested region. Consequently Dr. Britton went to Stonington, June 7th and remained until June 17th. Mr. Walden then took charge of the work until July 1st, after which it was in the immediate charge of Mr. James A. Hyslop, a student from the Massachusetts Agricultural College. In the caterpillar season extra help was needed; two Stonington men were employed, and several were sent out from New Haven, including two members of the station force of helpers. Later a number of local men were hired by the day to cut and burn brush. The wages paid for labor of this kind was $1.50 per day of eight and one half-hours, and some of the young men were paid $1.00 per day and board for banding trees and collecting caterpillars.

On September 1st the work was temporarily suspended in order to make the regular inspection of the nurseries of the state, as is required by law.

On November 16th the work of cutting and burning brush, pruning and scraping trees and scouting for egg-masses was resumed under the immediate supervision of Mr. George H. Hollister, a graduate of the Connecticut Agricultural College. This work is now going on, and the region is gradually reaching a condition far more favorable to the exterminative work than it has been during the past season.

The map facing page 236 shows the size of the area at present known to be infested and also the places where the egg-masses were found prior to May, 1906. These were clustered about the velvet mill as a center and the railroad is but a few rods distant.

The detailed description of the remedial measures adopted are given in the following paragraphs:

STATISTICS.

| | |
|---|---|
| Number of 1905 egg-masses destroyed | 29 |
| " " " " " hatched | 36 |
| " " 1906 " " destroyed | 47 |
| " " " caterpillars " | 10,000 |
| " " " pupae " | 47 |
| " " trees banded (more than) | 1,300 |

TREATING EGG-MASSES.

The experience in Massachusetts has demonstrated that gypsy moth eggs are hard to kill, and that creosote is one of the best materials for this purpose. A little lamp black is added to the creosote in order to give a dark color to the treated egg-masses. The creosote mixture is applied by means of a brush, and enough of it should be used to soak the egg-mass thoroughly, else some of the eggs may not be killed. Creosote mixture can be obtained from most of the seed stores and agricultural warehouses in the vicinity of Boston, and costs about seventy-five cents per single gallon, but can be obtained for less in large quantities. All egg-masses should be creosoted *in situ,* as an attempt to remove them generally results in breaking the mass and scattering the eggs, which will hatch the following spring.

### Banding Trees with Burlap.

Banding was commenced on May 16th, when 37 trees in the center of the infested region were banded with strips of burlap from eight to ten inches wide, placed around the tree and tied about the middle with wool twine. The upper half of the burlap is then folded over the lower half, covering the twine, as shown in the illustration. Light-weight, eight-ounce burlap is better than the more expensive grades for this purpose, because it is not so stiff, and rolls up better. In most of our work 40-inch burlap was cut in four strips of 10-inch breadth, but in the Massachusetts work bands only 8 inches wide are used, and burlap can now be purchased in strips ready to apply.

More bands were applied from time to time, as infested trees were found, until finally over 1,300 were in use. The caterpillars at first do not hide under the bands, but seclude themselves in crevices of the bark or under leaves. As they increase in size, however, they crawl under the bands and rest during the day time and feed at night. The men worked at banding in the morning and destroyed caterpillars in the afternoon.

Nearly all the caterpillars had transformed by the latter part of July, and only a few stragglers were afterward captured. Some pupae or cocoons were found under the bands, and the burlap was left on the trees until after the eggs had been laid, but most of the bands were removed before September 1st.

### Destroying the Caterpillars.

When we first began to look for caterpillars under the bands, we expected to find only a few, therefore a record was kept each day of the number found and the locality where taken. This system was continued throughout the caterpillar season, and in all over 10,000 caterpillars were destroyed.

At first the caterpillars were very small, and as we wished to save some of them for study, we killed them by dropping them into small vials of alcohol. This method was quite satisfactory, and was continued, though after a time the caterpillars were not saved. The territory to be covered was divided into sections; each man was made responsible for a section, and visited the bands once each day, usually in the afternoon, collecting the caterpillars with flat pointed forceps. The system

was a good one, but could not be used if the caterpillars were very abundant; it would be necessary to kill them by scrubbing the bark with a stiff wire brush as is done in Massachusetts.

### Sticky Bands.

Sticky bands are used in Massachusetts to prevent caterpillars from ascending trees not infested, or trees upon which the egg-masses have all been destroyed. "Tree Tanglefoot" is one of the best preparations for this purpose, as it remains sticky for a long time. It was given a trial in our work, and we shall use it more extensively next season. By applying it directly to the bark around the trunk of the tree, all crawling insects are kept from going up the tree, and a burlap band placed above the sticky band will trap those caterpillars already on the tree.

### Pruning and Scraping the Trees and Filling up Holes.

The gypsy caterpillars, though found on a variety of trees, were mostly on the larger apple trees of the region, and in some cases it was necessary to perform considerable labor upon these trees before the caterpillars could be captured under the bands. If the top of the tree is too thick and dark, the caterpillars will not crawl down and under the bands, but seem to find adequate protection in the tree tops. Wherever the trunk and larger branches are covered with rough, loose bark, the caterpillars hide in the cracks and under the upturned edges of the bark, where they often escape notice. Many trees had holes in the trunk and branches, the result of broken limbs, careless pruning or neglect. These holes furnish daily hiding places for the caterpillars, are favorite transforming places for them, and not only the cocoons but later the adult females and egg-masses are found in them. As some of these holes are inaccessible from the ground and too irregular on the inside to be readily examined, they are a distinct hindrance to the work, and it was necessary to fill them with stones and cement to keep the insects out. (See Plate VII, b.) No record was kept of the number of such cavities filled, but 700 pounds of Portland cement was used, and this was mixed with about three times its bulk of sand.

Much dead wood was removed from these trees, and living branches pruned away if needed. The rough bark was then scraped off, leaving the trees in much better condition for conducting an efficient campaign against the gypsy moth. Incidentally it was also a great benefit to the trees.

## Marking Infested Trees.

All trees found infested have been marked by the method adopted in Massachusetts, so that if any new men are engaged in the work next year they will have no difficulty in knowing where the insect was found and treated the year before. All infested trees were marked in white paint with a figure 6, usually placed on the south side of the trunk. On two other sides, equidistant from the figure, and on the same level with it, were placed vertical marks or lines, signifying that caterpillars were found upon the trees in 1906. Where egg-masses were found, a horizontal line was placed at the top of the vertical mark and extending to the right and forming a right angle with it. As the trees were thus marked on three sides, one or two of the marks could be seen from any point of view. Marked trees are shown on Plate VI, b.

## Burning Out Stone Walls.

On June 30th a bunch of wild rose bushes growing beside the road on North Main street was found to be infested, and 955 caterpillars were gathered. The bushes stood close beside a retaining wall and this wall was burned out by forcing a flame into the crevices. For this purpose fuel oil costing 5¾ cents per gallon was forced through a spray nozzle and the spray ignited, forming a gas torch. The pressure of the pump was sufficient to drive the flame through between the stones, the heat destroying the caterpillars there. Other sections of stone wall on Messrs. Darrell's and Atwood's places were burned out in this manner during July, and Plate VI, a, shows the operation.

## Overhauling and Relaying Stone Walls.

Though caterpillars can be killed readily by a flame, egg-masses require the flame for a long time in order to destroy

the eggs inside. Consequently the burning out process is not certain to kill all the eggs. Around the places of J. Chesebro, Fred Allen, Fred Avery, and under the two cherry trees beside the road near Bella Vista, sections of the stone walls several rods in length were overhauled, and several egg-masses found. These were creosoted, and the walls relaid.

## Spraying.

Spraying the trees with poison was not attempted until June 30th, when a number of trees on the grounds of Mr. H. Lee of Elm street were sprayed with arsenate of lead. It was then rather late for spraying work, as the larger caterpillars are difficult to kill. Two barrels of the mixture were used in the proportions of one pound of the poison in ten gallons of water. As caterpillars were afterwards gathered from these trees, it is certain that all were not killed by the poison, but had the spraying been done while the caterpillars were small, it surely would have proved more effective.

## Cutting Brush.

It has been mentioned that about five acres of brush around the pond by the velvet mill had been cut over and burned prior to May 1st, 1906. During the progress of our work it became evident that the brush and the stone walls, especially where both occur together, constituted the greatest hindrance to the extermination of the insect and that it was very necessary to cut and burn, in order to surround the infested area with a zone where there was little or nothing for the insect to eat and which would therefore serve as a barrier to further spread of the infestation.

The present statutes do not empower the state entomologist to destroy property of any kind, though he may under certain conditions order the owner to do so, and a failure to execute the order is punishable by a fine. Yet as the work here was aimed toward an extermination of the pest from this locality, it was deemed best to have it done under our direction rather than oblige the owners to do it. Therefore the owner's permission had to be secured in each case. Several men were kept

busy cutting brush during the last week of July and the month of August. Nearly all the brush was cut around the worst infested sections, but some of it was not burned until November.

The selectmen of Stonington, after consultation, had a force of men cut the brush on North Main street from the railroad station as far north as the Hull estate; through Loper's Lane; and out the Westerly road as far as Davis' ledge. This brush was all burned in August by our men.

Late in November a force of men under the supervision of Mr. G. H. Hollister finished burning the brush cut in August, and cut and burned over a large area further north.

## Scouting in Other Places.

Mr. Mixter examined trees along the railroad in the vicinity of New London during the first week in April. On April 16th Mr. Walden, assisted by F. B. Kellogg and O. M. Butler, scouted the regions of Mystic and Midway, going first to Mystic and examining the trees along the railroad both east and west from the depot and for a distance of about two hundred yards from the railroad track. This included the street trees and all of the many fruit trees in yards and gardens. In the afternoon the region about Midway was scouted, the area north of the tracks and east of the depot being covered with small scattering oak and birch trees. A narrow strip next the freight yard was examined. A number of scattering trees south of the freight yard and the wooded hill near the icing plant were all carefully looked over. The orchard south of the tracks and west of the river was also inspected.

The following day Plainfield, Danielson and Putnam were visited for the same purpose. There are few trees near the railroad station at Plainfield, but a little way to the north and west of the tracks a young apple orchard was examined, and also some forest trees along a stream east of the tracks. Some fruit trees in two or three yards east of the depot and the shade trees along the main street were looked over for a distance of about two hundred yards. The native vegetation along the railroad towards Providence for some distance was examined.

At Danielson the few trees near the railroad to the north and west were carefully examined.

In Putnam the trees on a strip about a block wide each side of the railroad and extending northward as far as the bridge crossing the tracks, and southward as far as the houses extend, was carefully inspected. Mr. Kellogg scouted around Willimantic during the forenoon of April 18th, but we have no record of the exact territory examined. The gypsy moth was not found at any of these places.

Later in the season visits were made to Westerly and Watch Hill, R. I., Mystic, Noank, Groton, New London and Norwich, and though no systematic search was made, a constant watch was kept for some indication of the presence of the pest, but none found.

## Educational Work.

As the gypsy moth has already appeared in Stonington, and as it may be found at other points at any time, and may finally spread throughout the state, the importance of having the people familiar with it cannot be overestimated. They will then recognize it when it appears, and thus be prepared to combat it.

A bulletin (No. 153) was prepared and sent out in March, treating of both the gypsy and brown-tail moths. This publication was illustrated with the best text-figures that we could obtain at short notice, and was printed in an edition of 10,000 copies. A portion of this bulletin was included in the Report for 1905 (see p. 246), with new and original illustrations. The text-figures are wood engravings, but on account of the quality of the paper on which they are printed, did not convey a good idea of the insect, and all were too dark. The cuts were arranged and printed on cards 11 x 14 inches in size, with a brief account of the gypsy moth and its ravages, for supplying schools, so that children might become familiar with the insect. A copy was sent to each public library in the state, and the following letter was sent to the clerk or secretary of the board of school visitors in each town:—

DEAR SIR:—You have doubtless learned of the appearance of the gypsy moth in Connecticut at Stonington. Probably it will later be discovered in other localities.

In order to control this terrible pest it is highly important that the people be somewhat familiar with it in advance, so that they may readily recognize it.

We have just printed, for hanging in schools and other public places, cards 11 x 14 inches in size, giving illustrations of the insect, with brief descriptions and instructions regarding habitat, damage and remedies.

A limited number will be furnished to your town without cost, if you will see that they are promptly distributed and placed in the schools. Please reply early, stating the number of cards desired.

Very truly yours,

W. E. BRITTON,

*State Entomologist.*

These letters were first sent to Windham and New London counties, in the eastern portion of the state, and then to adjoining counties, until the whole state was finally covered.

Of the 172 letters sent out, replies have been received from 96, and of the 168 towns in the state 95, or 57 per cent., have been supplied. A number have been given away to teachers visiting the station. An edition of 2,000 of these cards was printed.

Life history sets of the gypsy moth in Riker mounts 6½ x 8½ inches in size were prepared, mostly from purchased material, and placed on exhibition in drug store windows in Stonington, Mystic, Groton and New London and in the post-office at Noank. Sets were also placed in the factory of the American Velvet Company and the office of the Adams Express Company at Stonington; the office of the Secretary of the State Board of Agriculture, North Stonington; the E. C. Scranton Memorial Library, Madison; the New Britain Institute, New Britain; and the Young Men's Institute, New Haven.

Samples were shown at many farmers' institutes, and other agricultural and scientific meetings during the season. An illustrated lecture on the gypsy moth was given in Borough Hall, Stonington, on Nov. 26th. Lectures and informal talks were given about the pest in different parts of the state; exhibits of specimens and photographs were made at the annual

fruit exhibit of the Pomological Society at Willimantic Fair; at Milford Grange Fair, and at the meeting of the Board of Agriculture at New Haven, Dec. 18 to 20.

Information was given out to newspaper reporters and all others, when asked for, and a signed statement explaining the progress of the work was sent to four newspapers of the south-eastern portion of the state on July 7th, and this statement was copied by many other papers.

A list of references to American literature on the gypsy moth was published in the monthly book list of the State Board of Education for July. This list was in large part prepared by the state entomologist.

### Rearing Adults for Exhibition.

On account of the difficulty experienced in obtaining material illustrating the life stages of the gypsy moth, we took advantage of the opportunity to secure material of this kind within the state. A breeding cage (see Plate VII, a) about 3 x 3 x 5½ feet was built, having wood bottom and frame covered with wire netting. Caterpillars were collected from the bands, placed in this cage, and fed upon apple leaves until they reached the proper size for inflating. Some were inflated to show the larval stage, others were allowed to reach the pupa stage, while the remainder were kept until the adult stage had been reached and several egg-masses obtained. This gave us an opportunity to observe the habits of the insect, and material was obtained for about thirty-five complete life-history sets.

This breeding cage was kept within the already infested area and secured by a lock.

### Funds for Carrying on the Work.

At the start, the only money available for suppressing the gypsy moth was a part of the annual appropriation of $3,000.00 made by the legislature to the station for the expenses of the state entomologist in insect work. As this work has been organized and conducted for five years under the present management, the office force and the traveling expenses, especially during nursery inspection, require a large part of the fund. Nevertheless, some of it was available for this work, and

the Board of Agriculture promptly and kindly placed at our disposal $2,000.00 of their appropriation in case it was needed. The Governor and other members of the State Board of Control gave us to understand that if additional money was needed after these funds were expended, it would be forthcoming. We drew upon the treasurer of the Board of Agriculture to the extent of $800.00, and the rest of the money expended in the work came from the insect pest appropriation.

It was extremely fortunate that through the appropriation for entomological work the State of Connecticut had made it possible to vigorously attack the gypsy moth as soon as it made its appearance and that the funds of the State Board of Agriculture, and the disposition of the members of the Board, made it possible to continue the work when the funds of the entomologist were exhausted.

## Local Coöperation.

I desire to here express my appreciation to those citizens and residents of Stonington who have taken an interest in the work.

It was very fortunate for Connecticut that Mr. Ernst Frensch let the matter be known so early in the history of the moth colony. Had it gone another year before the matter was brought to our attention, it would have been more difficult to control it.

The board of selectmen, consisting of E. P. Couch, James E. Lord and Charles H. Holdridge, deserve commendation for promptness in cutting the brush along the highways for some distance outside the infested region, when they learned that it would facilitate our work.

Mr. E. M. Phelps expended considerable money in cutting the brush on his own land, which is near the border line of the infested region. It is hoped that more property owners will clean up their own land in this way, and not throw the expense of the work wholly upon the state.

## Congressional Appropriation for Gypsy Moth Work.

During the last few days of June, near the close of Congress, the agricultural appropriation bill was passed. This appropriated $80,000 to be used by the Bureau of Entomology of the United States Department of Agriculture against the

gypsy and brown-tail moths. When this appropriation finally became available the caterpillars were nearly full-grown, and the state work at Stonington was well organized and a force of men at work destroying caterpillars. Nevertheless the Bureau of Entomology wasted no time, but engaged as its field agent in charge of this work Mr. D. M. Rogers, who had been assistant superintendent of the Massachusetts work under Mr. Kirkland. Mr. Rogers visited Stonington on July 14th and looked about the infested region, inspected the work and made a number of suggestions, which we adopted. Mr. Rogers again visited Stonington on August 18th.

## Government Coöperation.

I was asked by telegram to meet Dr. L. O. Howard, Chief of the Bureau of Entomology, at Boston, July 18th. Prof. E. D. Sanderson of New Hampshire and Mr. A. E. Stene of Rhode Island were also present, and we talked over coöperative work. Dr. Howard inquired what he could do for us in Connecticut, and stated that the Bureau would take some of our men upon its pay rolls, or they would take a certain part of the territory and put in men to do all the work.

I replied that I believed the area infested to be a small one; that at present we had adequate funds available; that our work was organized and well under way; that the caterpillars were comparatively few in number, and therefore the danger of their spreading was not great; that cutting brush and cleaning up so that we could better fight the pest next year was the chief work to be done. I told him that I believed that Connecticut could handle the problem at Stonington, but that if later we needed help or funds, or should the pest be found in other parts of Connecticut, we might be very glad to have the Bureau coöperate in the work. Dr. Howard expressed his opinion that it would be best for each of the infested states to first expend some money in the suppression work.

It was therefore arranged that the Bureau should begin work in New Hampshire, Massachusetts and Rhode Island, and for the present not put men into Connecticut.

In November it was arranged by correspondence that the Bureau send some scouts to hunt not only around Stonington

but also in other portions of the state, and it is expected that this work will soon be started.

## How Did the Gypsy Moth Reach Connecticut?

There has been much speculation regarding the introduction of the gypsy moth into Stonington. Perhaps it will not be known just how it came, but as Stonington is only fifty miles from Providence, which has been infested for several years, and less than one hundred miles from Boston, it seems probable that the pest was brought from one of these places. The species was first discovered by Mr. Frensch near the railroad

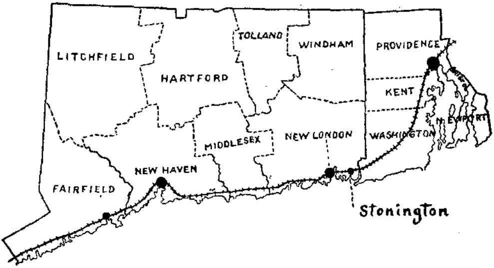


Fig. 2. Map of Connecticut and Rhode Island showing location of Stonington.

at the point where the spur track leading to the dock, branches off from the main track. There are side tracks here where cars are left standing. Few trees grow in this immediate vicinity, and those are toward the velvet mill. The gypsy moth may have been brought in the egg or pupa state on packing boxes to the velvet mill, and of course may have been dropped from passing automobiles.

On the other hand, it has been suggested that it may have been a direct importation from the old country. A number of Germans work in the mill and live close by, and as these people occasionally travel back and forth, eggs may have been brought with their baggage, accidentally, of course. This is possible, but the first theory here given seems the most probable explanation of its occurrence in Connecticut. Fig. 2 shows the relative location of Stonington and Providence.

CONDITION OF THE INFESTED AREA IN MASSACHUSETTS.

In June, as a delegate with Secretary Brown of the Board of Agriculture, I attended by invitation an exhibition of gypsy moth work at Malden, Mass., which had been arranged by the superintendent of the work and the Massachusetts Board of Agriculture. The various spraying outfits and special devices for banding trees, destroying caterpillars, etc., were exhibited, as well as the tremendous damage caused by the pest. Dead trees and hundreds of acres defoliated made a lasting impression of the destructiveness of the gypsy moth.

The next day was spent with Superintendent Kirkland and Dr. E. P. Felt of Albany, N. Y., in going through the infested portion of the state by automobile. At the insectary at Saugus we saw the breeding cages of the imported parasites and predaceous beetles.

The whole visit was very instructive and proved to be of great help in our Connecticut work.

The worst infested area of Massachusetts includes the towns of Medford, Melrose, Malden, Saugus, Wakefield, Stoneham, Woburn and Winchester. In the country districts between the populous centers is where the most damage had been done. In some places the fields of grass were thoroughly infested and the yield of hay greatly lessened. In walking over such a field, one would find a number of caterpillars crawling on his trousers and other clothes. Along the roadsides the same condition was found, and the shrubbery was brown through defoliation. Caterpillars fairly swarmed upon the trunks of trees, and over the ground in some places. This condition showed the extreme danger of the caterpillars being carried on vehicles, for after examining the trees, we had to inspect each other and take off the caterpillars, or we might carry them with us for a long distance in the automobile.

It should not be understood, however, that this condition exists everywhere,—it is so in some of the worst infested localities, because, as Superintendent Kirkland informed us, they had not yet been able, with the funds and forces at their command, to clean up these outlying districts. In each town, the work, as soon as organized, was commenced around the city or village, and gradually extended outward. We saw the street

trees and the shade and fruit trees of private gardens in good condition, and few caterpillars were to be seen. I do not remember seeing a single caterpillar in Boston. In Cambridge the street trees were banded, and numerous black spots on the bark of trunks and branches showed where egg-masses had been creosoted. But the amount of money required to hold this pest in check where it has once gained a foothold is simply enormous.

## Present Distribution of the Gypsy Moth in America.

From the original infestation in Medford the gypsy moth spread in all directions, going somewhat faster toward the northeast, until in 1900, when the work was discontinued, the pest covered an area of 359* square miles. The northeastern limit was Manchester, and it was found as far west as Lincoln and as far as Hyde Park to the south. There was also a detached area at Georgetown. In 1905 the infested area was 2,224 * square miles, the western limit being Marlborough. It extended from Wareham on the south entirely across the remaining portion of Massachusetts though the coast region of New Hampshire into Maine, where it has been found at Kittery, York and Eliot.

The infestation in Rhode Island extends over the entire city of Providence and a portion of Cranston, being nearly twenty-five square miles in extent. In Connecticut about one square mile is known to be infested.

## Methods of Spreading.

The gypsy moth would spread very slowly if not transported. The females fly but little if any, and often die on or near their egg-masses and not far from the cocoons from which they emerged. Mr. Frensch believes that the unfertilized females can and do fly as far as two hundred yards, but the evidence gathered in America does not bear out his belief. Fernald states† that he has never known the females to fly voluntarily either in this country or in Europe, and he has observed them in both places. They will sometimes drop when disturbed, and

* Kirkland, First Annual Report of the Superintendent for Suppressing the Gypsy and Brown-Tail Moths. January, 1906.

† The Gypsy Moth, p. 344.

by spreading their wings they can flutter or sail slowly to the ground a few feet away from the tree. Mr. Mosher observed one in the forest at Woburn, Mass., in 1895, which thus flew about twenty feet.* During the season Mr. Hyslop took females from our breeding cage and placed them at different positions on the walls and about the room in his house. Both fertilized and unfertilized females were tested regarding their ability to fly, the former before and after ovipositing. In all cases the results were the same. They could not be made to fly, no matter how much they were disturbed, and would do no more than drop to the ground, and few even moved their wings.

The males are not even nocturnal, but fly about in the daytime in a peculiar zigzag course, and through their scent organs are attracted at least half a mile by the unfertilized females.†

As a rule the caterpillars do not crawl far if the food supply is abundant, but sometimes when disturbed they become scattered, even where there is plenty of food. When fullgrown and about to transform, they crawl to seek sheltered places such as holes in trees, the under side of fence rails in the corners by the posts, and many caterpillars pupate under the burlap bands. But when the caterpillars become so abundant as to devour all tree foliage, as in some parts of the infested region in Massachusetts, they will crawl long distances in search of food.

The species is chiefly distributed by other agencies. When small, the caterpillars have the habit of spinning down on silken threads like the cankerworms, and may thus drop into a wagon, automobile or upon an electric car, and be carried long distances. Railroad trains are not apt to transport caterpillars in this manner because trees do not hang over the track, but baggage and persons entering the coaches might easily carry them aboard. Then as the caterpillars become larger they crawl about more, and in a badly infested region might easily crawl upon freight cars standing in the yard or upon a siding, and on the moving of these cars, might be carried many miles. Caterpillars also hide on or in these cars or some por-

* The Gypsy Moth, p. 344.

† Idem., p. 345.

tion of the freight, and there transform to the pupa stage. Ten days later, perhaps in another state or part of the country, the adult emerges.

Now if it happens that but a single specimen is carried in this manner, little harm will be done, for it will die without reproducing. But should two or more specimens representing both sexes be carried into the same locality and complete their transformation safely, a new colony arises.

Not only are vehicles and railroad trains capable of carrying caterpillars, but persons traveling about in an infested region are liable to carry the caterpillars upon their clothing, and domestic animals may carry them in their hair. It is said that even birds sometimes gather caterpillars and during flight drop them before killing them. Birds may also carry small caterpillars on their feet and feathers.

## Present Condition of the Infested Area in Connecticut.

Though over 10,000 caterpillars were killed, it is very doubtful if any plant or tree was eaten sufficiently so as to be noticed by anyone not making a study of entomology or pests of plants. Had these caterpillars lived, they might as they became larger have done enough injury to attract attention.

Some leaves were more or less eaten, but this might have been attributed to canker worms or tussock moths, the latter being abundant.

At the present time it is difficult to find any egg-masses, or in fact any traces of the presence of the gypsy moth in Stonington, except for the marked trees and the cutting of the brush along the roadsides and around the fields. Altogether, the region is being put into a condition favorable for a successful campaign against the insect next season.

## Natural Enemies of the Gypsy Moth in Connecticut.

In gathering caterpillars from the bands a number of other insects, especially beetles, were found under the bands. Most of these doubtless crawl under the bands, like the gypsy caterpillars, to hide from their enemies, and there remain during the day. A large green carabid beetle, *Calosoma scrutator* Fabr., sometimes called the "searcher," was rather common under

the bands. As the beetles of this family are known to be predaceous, it was thought that this species, which is a large one, might devour gypsy caterpillars. Mr. Cleveland captured one and took it home alive and fed it some of the gypsy caterpillars, which it ate greedily. He kept a record for thirteen days with the following results:

| | |
|---|---|
| July 10 | 6 |
| 11 | 11 |
| 12 | 7 |
| 13 | 12 |
| 14 | 10 |
| 15 | 7 |
| 16 | 14 |
| 17 | 10 |
| 18 | 9 |
| 19 | 16 |
| 20 | 10 |
| 21 | 14 |
| 22 | 12 |
| *13 days.* | *137 caterpillars.* |

Thus in thirteen days the beetle devoured 137 gypsy caterpillars, or an average of 10.5 per day. A member of Mr. Cleveland's family then fed the beetle with some caterpillars which had been killed by dropping them into alcohol. The beetle ate these greedily and soon died. This beetle is shown on Plate II, c. The men were then cautioned not to destroy these beetles.

The writer visited Eastern Massachusetts during the last week of June, and saw many caterpillars which had died from what appeared to be a bacterial disease. These were hanging from the rough bark of the trunks of trees, and were greatly shriveled and of lighter color than the living specimens. Prof. G. E. Stone, Botanist of the Massachusetts Agricultural Experiment Station at Amherst, was called upon by Mr. Kirkland to make an investigation of this disease. Four of these dead caterpillars were found at Stonington in the course of our work. Two of these were sent to Dr. Stone, who reported that he had isolated several organisms from the caterpillars but had not then determined which one caused their death.

### *Life History and Description.*

The gypsy moth passes about three-quarters of the entire year in the egg stage, the eggs being laid about the first of August and hatching about the first of May. The eggs are laid in oval-shaped masses more or less irregular and about an inch long, usually on the trunks or branches of trees, but also on fences, buildings and stone walls, as well as upon any rubbish which may occur in the vicinity. The egg-masses average between 400 and 500 eggs, though the number varies greatly,

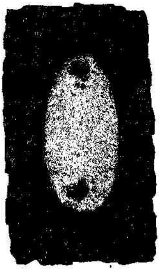

*Fig. 3. Egg-mass of Gypsy moth, natural size.*

and the eggs are covered with hairs from the body of the female, giving the mass a light brown color. See Figure 3 and Plate IX, a.

When first hatched, the caterpillars are very small, and are found upon the leaves. As they increase in size they feed at night and hide during the day under the leaves, in the crevices of the bark, and under rubbish or anything that will serve to protect them from birds and other enemies.

The full-grown larvae or caterpillars vary greatly in size according to their food supply, but the largest ones taken at Stonington were three and one-fourth inches long and three-eighths of an inch thick. In general the caterpillar is dark brown in color, some individuals being distinctly reddish, and others more nearly grey. There extends along the back a whitish line or stripe which appears faintly in some specimens

and is well marked in others. This line extends between two rows of colored tubercles or spots, the first five pairs being blue and the remaining six pairs bright red. These tubercles bear short, stiff black hairs. Longer light brown hairs are borne in tufts by two rows of tubercles on each side of the body, making in all six rows of tubercles bearing hairs. The front of the head or face is marked with two broad stripes nearly meeting at the vertex and diverging downward, somewhat resembling an

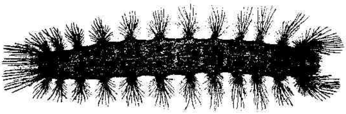

FIG. 4. Gypsy caterpillar, natural size.

inverted letter V. Between these lines the color is light brown or buff, and outside of them the same color is stippled with dark brown dots. Legs and prolegs are light brown. (See Fig. 4 and Plate VIII.) The largest caterpillars develop into females, and the sexes can usually be distinguished in the pupa stage, which is formed in July. The pupa is generally found upon trees in holes or crotches, or under fence rails, sometimes

FIG. 5. Chrysalis or pupa of Gypsy moth, natural size.

suspended by the apex, though sometimes inverted. Frequently six or eight pupae are clustered together. A loose web or cocoon consisting of a few threads of silk usually surrounds the pupa.

The female pupa is about an inch long and the male about three-fourths as large; both are dark brown in color with a

tuft of short radiating buff hair projecting from each abdominal segment. The pupa stage lasts from ten to fourteen days, and is shown in Fig. 5 and on Plate IX, b.

The adult moths emerge late in July, and the sexes are so unlike that they might easily be taken for distinct species by anyone not familiar with them. The female is nearly white, with transverse brown markings on the wings, but in some cases these markings are almost wanting. The wing expanse

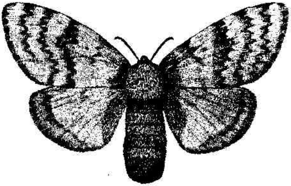

FIG. 6. Female Gypsy moth, natural size.

varies from two to three inches, and the abdomen is large and heavy. The wings are weak, and the female, not being able to fly, is usually found resting on trunks of trees, fences or buildings not far from her old cocoon. See Fig. 6, and Plates IX and X.

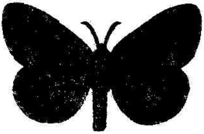

FIG. 7. Male Gypsy moth, natural size.

The male is brown, but varies greatly in color, and the wing expanse is about one and one-half inches. The male is shown in Fig. 7 and on Plate X, and is able to fly for at least half a mile.

After mating, the females lay eggs, and both sexes soon die.

## Food Plants.

Forbush and Fernald published ten years ago a list of about five hundred plants* upon which the gypsy caterpillars feed in Massachusetts. This list includes nearly all of the plants commonly grown by man, and a large number of our native species of great economic importance, as well as many others not especially important. In the very extensive feeding tests carried out in the course of the work in Massachusetts only nineteen species of plants were found which the caterpillars refused to eat. None of these plants are of such importance from the economic standpoint. In Massachusetts the insect feeds upon the foliage of nearly all kinds of trees and shrubs, the ash and the hickories perhaps being most nearly exempt of any of the shade trees. While in Massachusetts last summer Mr. Kirkland called my attention to a white ash tree with foliage uninjured, though all of the other kinds of trees near it were stripped. I also saw hundreds of acres of oak and chestnut which had been defoliated. In fact, these trees seem to be favorites of the caterpillars in the woodlands.

In Stonington nearly all of the caterpillars and many of the egg-masses were taken from apple trees. A few were found on pear, sweet cherry, quince and red apple. A clump of wild rose bushes contained nearly a thousand caterpillars. Apparently apple trees are preferred, and where the insects occur only in limited numbers they can of course exercise their preference in regard to food.

## Remedies.

The methods of suppression set forth in the preceding pages have mostly been worked out during an extended experience in combating the insect in Massachusetts, and we, of course, have been ready to adopt the best ones, giving the Massachusetts authorities full credit.

The period in the life of the gypsy moth during which we can best destroy the pest is the egg stage,—(1) because the insect passes nine months of the year in this condition, giving us plenty of time to hunt it; (2) it does not move about in

* The Gypsy Moth, a report of about 500 pages, published by the Mass. Board of Agriculture, p. 316. 1896.

this stage, and an area which we have examined will not become infested until after the eggs hatch, except through transportation. The eggs are killed by saturating the mass with creosote, but if brush areas are infested cutting and burning is the best treatment.

During the caterpillar stage is the next most important time for us to practice remedial measures, and of these, trapping the caterpillars is probably the most important and effective if rightly managed. Bands of burlap eight to ten inches wide are placed around the trunk at a convenient height and tied at the middle with wool twine. The upper half is then folded over the lower. Caterpillars crawl under this to hide during the day, and the bands are examined every day or every other day and the caterpillars destroyed by crushing or dropping them into some liquid to kill them.

Caterpillars nearly grown are not readily killed by poison. When small, however, a spray of arsenate of lead, one pound in ten gallons of water, applied so as to thoroughly cover the leaves, will destroy many of the caterpillars. It is hardly worth while spraying unless it can be done before June 20th. Caterpillars in stone walls can be destroyed by a thorough use of the gas torch.

The caterpillar stage lasts less than two months, and the last half of this period is the best time to trap them under the bands.

The pupa stage lasts only from ten to fourteen days, hence is a short period in which to combat the insect. Pupae should be destroyed wherever they occur. Many will be found under burlap bands, under loose bark, fence rails, in holes in trees, or in fact in any secluded place.

Adult females should also be killed when found, though if they have laid their eggs it makes little difference, as they will soon die naturally, and if killed the egg-mass remains to supply the crop for next year.

### Importation of Parasites and Natural Enemies.

The Massachusetts law enacted early in 1905 provides that ten thousand dollars each year for three years may be expended in experimenting with parasites and natural enemies of the gypsy and brown-tail moths. Soon after being appointed,

Superintendent Kirkland sought coöperation with the Bureau of Entomology at Washington, which had been granted $2,500 by Congress for similar purposes. Dr. L. O. Howard personally undertook the importation of parasites and predaceous beetles, and visited some of the leading entomologists of Europe in 1905, and enlisted their coöperation. Dr. Howard made a second trip to Europe in the spring of 1906. Many nests of the brown-tail moth were collected and sent to Mr. Kirkland, and were afterwards placed in cages that would allow the small parasitic insects to emerge without escaping. They were collected in tubes, in which they could be examined, and many secondary parasites and hyperparasites were found. It was necessary to destroy these, for if allowed to escape, they would parasitize the insects attacking the gypsy and brown-tail moths, and perhaps render valueless the whole attempt to control these pests by importing parasites.

Some of the hymenopterous parasites were let loose in Massachusetts during the gypsy caterpillar season of 1906.

A two-winged fly, *Tachina larvarum,* promises to be of some immediate value, according to Dr. Howard.*

Two predaceous beetles belonging to the genus *Calosoma* have also been imported, and feed upon the caterpillars.

This experiment of importing parasites is of great interest, and we hope to be benefited by it, but so many problems connected with it yet remain to be solved that no one can say what the outcome will be. People as a rule, through their eagerness for relief, place too much reliance upon the control of insect pests through the importation of parasites. The idea has been exploited in the magazines and newspapers by certain sensational writers, who make it appear not only a very simple matter, but the only rational means of controlling insect pests. This often does much harm because it discourages people from attempting any other control methods, such as spraying by banding trees. Entomologists know that the matter is not so simple as is often claimed; they know that many parasites have been imported into this country that have failed to show any beneficial results whatever. Climate, natural enemies and food

* First Annual Report of the Superintendent for Suppressing the *Gypsy and Brown-Tail Moths,* p. 126.

supply are factors in the prevalence of any species whether imported or not and these conditions are not under control. The lady beetle imported from China to destroy the San José scale does not thrive in the East—at least in the Northeast—and many colonies let loose have not been seen since. If parasites are imported, they are liable to be attacked by some native species of hymenoptera that will prevent them from multiplying sufficiently to do an important work in keeping down pests. When we realize that each species has its parasites, and that from the pest we may rear four or five species, each of which is parasitic upon one of the others, and only one of them attacks the pest, it will appear to be a very complex problem instead of a simple one.

But as the bringing in of parasites is not liable to prove detrimental and may prove distinctly beneficial, it is always an experiment worth trying if carefully conducted. It is to be hoped that the gypsy and brown-tail moth pests may be controlled by these imported enemies; but it would be the height of folly to discontinue other control measures, at least until after the parasites had thoroughly demonstrated their usefulness.

## THE SPINY ELM CATERPILLAR.

During the first half of the summer the spiny elm caterpillar was very abundant, and defoliated trees or portions of trees in all parts of the state. Specimens were sent in by twenty-six correspondents, some mistaking it for the gypsy caterpillar, to which it has little resemblance.

The spiny elm caterpillar is the larva of one of our common and widely distributed butterflies known as the "mourning cloak," and as the Antiopa butterfly (*Euvanessa antiopa* Linn.). It feeds upon elm, poplar and willow, often stripping small trees and certain branches of large ones. The species hibernates, or passes the winter in the adult or butterfly stage.

### LIFE HISTORY.

The eggs are laid in cylindrical clusters surrounding the twigs during the first half of May, when the leaves are about full size. About 300 eggs are usually found in each cluster,

though 450 have been known to occur in a single cluster. Two weeks are required for the eggs to hatch, and the caterpillars, being gregarious, place themselves side by side, with heads toward the edges of the leaf. They eat away the green portion, leaving only the network, and each spins a silken thread wherever it goes, so that something of a web is found in connection with the caterpillars, though not covering them. They eat voraciously as they become large, and devour all but the midveins. As they are still gregarious, they may be seen in large clusters on the ends of branches which they have defoliated, and therefore attract much attention. They reach full size the latter part of June or about July 1st, after having molted, or cast their skins, four times. The caterpillars then cease feeding, and scatter abont seeking places to pupate, such as the underside of a rail or branch, or a hole in a stump; spinning a web of silk on the surface, it fastens itself by the tail and again casts its skin and becomes the pupa or chrysalis. About two weeks later the adults appear, and about the middle of July eggs for the second brood are deposited. The caterpillars of the second brood become fully grown about September 1st, but are not as abundant as those of the first brood in June. They then pupate, and the adults, emerging two weeks later, live through the winter in sheltered places in the woodlands, and lay eggs the following spring. We may see this butterfly on warm, sunny days in February and March flying about in the forests and pasture woodlands. There are two broods each year in Connecticut, but Weed found* only one in New Hampshire in 1899, and Felt suggests† the possibility of a third generation in New York State during certain seasons.

The adults visit various flowers to obtain nectar, and feed upon the sap of the maple and various other trees as it exudes from wounds, or from logs and branches where trees have been cut. They are not able to pierce plant tissues nor eat solid food, consequently they do no harm to vegetation in the adult stage.

This butterfly is found throughout the temperate regions of the globe, being more widely distributed than most butterflies.

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* Bulletin 67, New Hampshire Agr. Exp. Station, p. 132. 1899.
† Insects Affecting Park and Woodland Trees, p. 160.

## Description.

The full-sized caterpillar is not far from two inches in length, black in color, though sprinkled over with small white dots arranged in transverse rows, giving the caterpillar a hoary or greyish appearance. Along the back is a row of red spots somewhat diamond-shaped. Each segment bears a number of black branched spines, arranged approximately in transverse rows.

The adult or butterfly has a wing spread of about two and one-half inches, and is of a purplish brown color, with yellow margins on the wings. Many small, irregular brown spots occur in the yellow margin, and just inside it is a row of blue spots. On the under side the wings are black, with light-colored margins as above.

The pupa or chrysalis is about an inch long, suspended by the tail, with a row of spine-like projections along the ventral surface, and two pointed tubercles on the apex of the head. The color is purplish grey. All stages of this insect except the egg are shown on Plate XI.

## Natural Enemies.

Spiny elm caterpillars are eaten by cuckoos, but few birds attack them, probably on account of their spines. Toads will eat them if they are found upon the ground, and a large beetle called the "searcher" or "caterpillar hunter" (*Calosoma scrutator* Fabr.) is known to feed upon them. This is the same beetle shown on Plate II, c, and mentioned on page 253 as devouring gypsy caterpillars. The most important natural enemies are insect parasites. One of these, a minute four-winged fly bearing the scientific name of *Telenomus graptae*, attacks the eggs. A number of chalcid and ichneumon four-winged flies (Hymenoptera) and certain two-winged flies (Diptera) are known to parasitize the caterpillars. As a rule, the spiny elm caterpillar is held in check by these natural enemies, and only occasionally does it appear in such numbers as in 1906.

## Remedies.

A spray of Paris green or arsenate of lead will preserve the foliage from destruction, but as the spiny elm caterpillar is

found only here and there on a small tree or on a single branch, it is hardly worth while to practice spraying. When small, the end of the branch can be cut off, and the insects destroyed by crushing or by dipping in kerosene. When large they can be knocked off by striking the limb with a padded mallet, or with a stream of water from a hose. The caterpillars can then be destroyed upon the ground.

## INSECT ENEMIES OF THE TOBACCO CROP IN CONNECTICUT.

Four years ago, or during 1903, it was planned to make a study of the insects attacking growing tobacco plants, and the work actually begun, but the season was remarkable for the scarcity of tobacco insects, and therefore little progress was made. The following season was similar in this respect, and few insects were observed on the plants in the field. In 1905 and in 1906 tobacco worms were fairly abundant in certain parts of the tobacco region, and in visiting many different fields and making collections from them we were able to acquire data regarding the various insects and the relative damage done by them. Some of these were studied in breeding cages at the station; plants growing outside were covered with cages, and the insects placed upon them and the injuries noted.

From the various papers which have been published regarding the tobacco insects of other sections of the country, it appears that Connecticut tobacco fields are more nearly exempt from the attacks of insects than are the fields of most other tobacco-growing regions of North America.

### Key to the Common Injuries to Tobacco Plants Caused by Insects.

*Roots and stem injured*—

Plants, when small, cut off near the ground, or leaves eaten during the night. Fat brown or grey worms coiled up just beneath the surface of the ground near *the injured plants* .................................*Cutworms.*

Slender yellow worms boring in the roots and lower stem below the surface of the ground ........................................Wire worms.

Leaves eaten—

Leaves, in July and August, wholly devoured except midrib by green caterpillars with horn on tail; caterpillars finally becoming three to four inches in length ........ Tobacco worms

Surfaces of leaves (chiefly under surface) eaten so as to form whitish spots or patches which later drop away; injury caused by small black jumping beetles ........ Flea beetles.

Irregular holes in leaves, or edges eaten ........ Grasshoppers or tree crickets.

Leaves punctured by sucking insects—

Large top leaves wilting from puncture of midvein ........ Spined Tobacco Bug.

Green insects with long legs and antennae on under surface of lower leaves ........ Plant Lice.

Whitish scale-like larvae on under surface of leaves. White moth-like adults flying about ........ White Fly.

Eating dried tobacco—

Small circular holes eaten by brown beetles, larvae often found in the burrows. Stored tobacco, cigars and cigarettes attacked ........ Cigarette Beetle.

## CUTWORMS.

Cutworms are the larvae or caterpillars of several species of moths of the family *Noctuidae*, commonly called owlet moths. They cause much injury to gardens and field crops of all kinds, but are especially injurious where the plants are transplanted from frames or seed beds into the fields which have recently been plowed and harrowed. As a rule the operations of fertilizing the soil, plowing and harrowing take time, and several days perhaps elapse from the plowing of the field to the setting of the plants. During this time the cutworms are in the soil, and are forced to go without food, as the weeds and other plants have been destroyed by plowing; consequently they are very hungry, and attack the plants soon after they are set. Tobacco, cabbage and tomatoes are the crops most seriously injured, these being the crops grown most extensively from transplanted plants. Crops grown from seed are also often seriously damaged by cutworms.

Most species of cutworms have but one brood each year and the eggs are laid upon grasses during the latter part of the summer. The larvae feed upon the roots of grass and other plants, going deeper into the ground on the approach of cold weather. In the spring they come to the surface of the soil and attack the plants, usually cutting them off.

Fall seeding with rye undoubtedly serves to furnish food for cutworms. Cutworms are usually more destructive on sod land or in fields surrounded by grass than elsewhere.

In June, 1905, cutworm injury was extremely severe throughout Connecticut, and in the tobacco fields it was necessary to reset plants one or more times in many cases. The writer visited the experiment field at Poquonock, and found that even the tobacco growing under cloth had been attacked, though probably not more seriously than that growing outside. Over one hundred cutworms were collected from the soil under or around injured plants of the shade-grown tobacco, and brought to the laboratory. Nearly all appeared to be larvae of *Agrotis ypsilon* Rott., known as the black cutworm, although the adults were not reared. This species is reported by Quaintance* as being the most common cutworm attacking tobacco in Florida, and Garman states† that it is especially destructive to newly set tobacco plants in Kentucky.

The injury to plants at Poquonock was marked by a lack of uniformity. Some plants were cut off just above the ground, some were severed three or four inches from the soil, and in many cases the cutworms had climbed higher, and instead of attacking the stems, had eaten away portions of the leaves, as if tobacco worms had been at work. No tobacco worms could be found, and as the cutworms were always discovered in the soil near the plant, there is little doubt about the cause of the injury.

Though the black cutworm seemed to be the most common, there are several other species doing similar injury in Connecticut. These belong chiefly to the genera *Agrotis, Feltia Noctua* and *Peridroma*. As the treatment for cutworms is general and applies to all species, we need not discuss them

* Bulletin No. 48, Florida Agr. Expt. Station, p. 181. 1898.
† Bulletin No. 58, Kentucky Agr. Expt. Station, p. 97. 1895.

separately here. In general all feed at night, and go under boards or rubbish or beneath the surface of the soil, where they remain coiled up during the day. They vary in color from a dirty white through the greys and browns to nearly black. Markings more or less inconspicuous serve to distinguish the species, but the grower seldom observes the markings, and it really makes no difference to him which species is causing the injury. The adults are all sombre-colored moths which fly at night and hide away in dark places to remain quiet during the day. The accompanying figure of the black cutworm will also serve to illustrate the other species.

When fully grown the black cutworm is about one and one-half inches in length and about one-fourth of an inch thick.

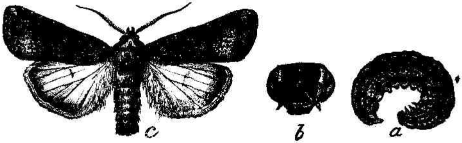



FIG. 8. The black cutworm *Agrotis ypsilon*. (After Howard, Bureau of Entomology, U. S. Department of Agriculture.)

Its color varies, but is usually a dull grey, brown or sometimes nearly black, with rather indistinct pale lines along the sides. The head is darker than the body, and the tips of the jaws are black. See Fig. 8.

The adult moth has a wing expanse of about two inches, and the head and body together extend from three-fourths of an inch to an inch. The forewings are brown, sometimes light and sometimes nearly black, marked rather inconspicuously with fine curved black lines. The apex of each is crossed by fine undulating white lines interspersed with dark and light spots, giving the entire end of the wing a paler color than the ground portion. The rear wings are nearly white, shaded with brown along the veins and margins, and edged with short white fringe. The adult is shown in the photograph reproduced on Plate XV, c b, and in Fig. 8.

Remedies against cutworms are trapping, fall plowing, and the use of poisoned bait, the latter being the most efficient and most practiced in tobacco fields. The best bait is probably a poisoned mash made of bran or wheat "middlings" with a little Paris green or white arsenic added, with enough molasses to sweeten it slightly. A teaspoonful of Paris green and a similar or larger quantity of molasses should be sufficient for each half-peck of bran. The mash should be scattered about over the field a few days before the plants are set, as the hungry cutworms will eat it and thus be prevented from injuring the plants. Some growers place a ring of this mash around each plant, and report no injury from cutworms. Mr. Roscoe H. Gardner of Cromwell stated in the writer's presence that his practice consisted of mixing one pound of Paris green with a sack of bran and placing a pinch of the mixture by the side of each plant; very seldom a plant was injured by cutworms. The chief objection to these last two methods is the labor required in distributing the mash. If placed upon the field at intervals of several feet apart a few days before the plants are set, most of the cutworms will find it and die without injuring the plants. This appears to be much the best remedy that can be recommended.

Another method is to distribute over the field bunches of poisoned clover or other fresh succulent plants upon which the cutworms feed.

Cutworms are sometimes trapped by placing small pieces of board about on the surface of the ground. The cutworms will crawl under these to remain during the day, and can be hunted and killed. In small gardens they can usually be controlled by hunting them each morning around the injured plants.

Late fall plowing uncovers many cutworms, exposing them to birds and other natural enemies, but it also turns under the hardy weeds and other plants growing upon the field, so that the food supply for the following spring is destroyed; the cutworms are then obliged to go to some other field or starve. Early fall plowing will tend to drive the cutworms to adjacent fields in search of food except where seeded with grass or rye, in which case they can find it without migrating.

## WIREWORMS.

Few accounts of wireworm injury to tobacco occur in the literature of economic entomology, though Howard mentions* the fact that they are sometimes injurious to young plants soon after they are set out, and Targioni-Tozzetti lists † nine species that attack tobacco in Europe.

Wireworms are the larvae of click beetles (family *Elateridae*), and are usually long and slender, of yellow or brown color and of firm texture. They are able to work their way into hard substances, and for the most part feed upon seeds, roots, tubers or other portions of plants under ground. Many other kinds feed doubtless upon decaying vegetable matter, and are not harmful in agriculture.

On June 11th Dr. Clinton brought in specimens from the tobacco farm of Mr. E. S. Hale in Portland, where many plants had been injured by wireworms. Mr. Walden visited the fields on the next day and found the wireworms attacking the roots and lower stem of the plants, causing serious injury. About five-eighths of an acre had been plowed up because the plants had been ruined. In a row of 225 plants, 80, or over one-third, showed injury, but this degree of injury and infestation did not extend over the entire field, and an adjacent field had only an occasional plant showing injury.

In some cases four or five wireworms were at work in the main root of a single plant, just beneath the surface of the ground. Two species were found here causing the injury, *Melanotus cribulosus* Lec. and *Asaphes sp.*, the latter being the more common. Adults of *Limonius griseus* Beauv, were found the same day resting on the plants. Though this is the only case of wireworm injury to tobacco that has come under our observation, the Connecticut tobacco growers report occasional injury, and from the appearance of Mr. Hale's field it is evident that wireworms may cause considerable damage.

Some of the most elaborate experiments in this country with wireworm remedies have been conducted by Messrs. Comstock and Slingerland of the Cornell Experiment Station,‡ and of

* The Principal Insects Affecting the Tobacco Plant; Yearbook of the U. S. Department of Agriculture for 1898, p. 122.

† Animali ed Insetti del Tobacco, p. 70.

‡ Bulletins 33 and 107 Cornell Univ. Agr. Expt. Station.

the many remedies which have been suggested from time to time, fall plowing is about the only one that is likely to be worth practicing. These insects live for at least three years in the larval or wireworm stage, pupating after midsummer of the third season, in earthen cells in the ground. The pupa stage lasts but three weeks, but the adults remain in these cells and do not emerge until the following spring. By plowing or other stirring of the soil in late summer or autumn many of these cells are broken and the insects destroyed.

### Tobacco or Horn Worms.

Year in and year out, the greatest insect injury to growing tobacco in Connecticut is caused by the large sphinx caterpillars, commonly known as horn worms, tomato or tobacco worms. These are the larvae of sphinx or hawk moths, and are called horn worms on account of the solitary horn borne upon the dorsal surface of the posterior extremity, as is shown on Plates XII and XIII. There are two species in Connecticut. The Northern tobacco worm, *Phlegethontius quinquemaculata* Haworth (formerly *Protoparce celeus* Hbn.), is the chief depredator in the tobacco fields of Windsor and East Hartford, and is the more abundant in Northern New England. The Southern tobacco worm, *P. sexta* Johansen (formerly *Protoparce carolina* Linn.), is common in the tobacco fields of Southington, and is much more abundant at New Haven than the other species. It is also the common tobacco worm of the South. Both kinds feed upon the tomato and sometimes attack the potato. There is no way of distinguishing these two species by their work, and it is often difficult to distinguish their caterpillars, though in general *P. sexta* has a red horn, whereas the horn of *quinquemaculata* is black. Both caterpillars are green with oblique white stripes on the sides of the body. In the pupa and adult stages there is no difficulty in distinguishing one species from another. The remedies are the same for both species, and it is not necessary that the grower should know them apart.

The eggs are laid separately on the under sides of the leaves, by the adults which fly only at dusk. Usually there is but one egg to a plant, but sometimes more, especially when the moths

are abundant. The eggs hatch in three days, and the young horn worm begins to feed upon the leaf, usually eating a hole through it. As it increases in size the caterpillar eats more and more, and will finally devour the entire leaf except the midrib, and may in fact eat several leaves. The horn worms are often detected by the excrement which drops to the ground or upon the lower leaves, or by the partially eaten leaves; the worms are often on the under side, where they would otherwise escape notice. These worms are seldom found in the Connecticut tobacco fields before July, and from then until the tobacco is harvested they continue to defoliate the plants.

When fully grown, the caterpillars are from three to four inches long, and they go into the ground and pupate several inches below the surface, where they remain until the following year. The pupa or chrysalis is naked, of dark brown color, about two and one-half inches long, with a curved appendage, or tongue case, on one side, which is popularly called the "jug handle." This is longer with *quinquemaculata* than with *sexta*, hence serves as a distinguishing character. See Plate XIII, b.

The adults of both species are called sphinx moths and hawk moths, and have long pointed heavy bodies with narrow wings, and a wing expanse of between four and five inches. The general color is brownish grey, and both species have black and white bands across the rear wings. The northern species has forewings marked with delicate lines, mostly parallel with the margins and all of a greyish color. The forewings of the southern species show a more brownish color and a more mottled appearance. On each side of the abdomen of both species there are five bright orange spots, and under the head the tongue or proboscis is coiled up like a watch spring. Once we took the trouble to uncoil the tongue from a specimen of *quinquemaculata*, and it measured four and three-fourths inches. This would reach to the bottom of the deepest flowers. Adults of both the Northern and Southern species are shown on Plate XIV, and tobacco worms are illustrated on Plates XII and XIII.

It is not certain whether more than one brood occurs each year, but if so, they are not well-marked, and during the latter part of the season larvae of all sizes are found. In our breed-

ing cages adults emerged as late as September 22d, whereas some hibernated as pupae. There are three and perhaps four broods annually in Florida, according to Quaintance.* Plate XIII, c, shows a tobacco worm which has been parasitized by a hymenopterous insect, and the parasites have emerged and fastened their cocoons to the back of the caterpillar. These parasites are four-winged flies, *Apanteles congregatus* Say being one of the chief species, and probably the one shown on the plate.

Remedies for tobacco worms consist in hand-picking, which is called "worming." Men are sent through the fields twice a week, every other day, or perhaps daily according to the abundance of the worms. So far as I know, Connecticut growers have never practiced spraying tobacco with poison to prevent injury from leaf-eating insects, though Garman in Kentucky† has demonstrated that so small an amount of Paris green as one pound in 160 gallons of water does not injure the tobacco, and states that spraying is coming into practice by the Kentucky growers. Quaintance writes‡ that arsenate of lead is used to some extent in Florida.

Another method of controlling this pest has been recommended for many years—that of poisoning certain flowers to kill the adults—but I doubt if Connecticut tobacco growers ever practiced it. The adult moths fly only at twilight, and by means of their long tongues they sip nectar from the flowers of the "jimson weed" (*Datura stramonium*), and doubtless from other deep-throated flowers. By placing a drop of poison in the throat of each of these blossoms, the moths would be poisoned when visiting them. But the "jimson weed" is not very common around tobacco fields in Connecticut.

As a rule tobacco worms cause no injury to tobacco under cloth, except the first year in case the pupae were present in the soil.

### Flea Beetles.

Flea beetles are responsible for considerable injury to tobacco, especially soon after setting the plants, and even later the lower leaves are often seriously eaten. Flea beetles usually

* Bulletin 48, Florida Agr. Expt. Station, p. 155.

† Bulletin 53, Kentucky Agr. Expt. Station, p. 125.

‡ Bulletin 48, Florida Agr. Expt. Station, p. 165.

attack the under surface of the leaves, where they eat away portions of the tissue. These injured spots become dried and drop away, leaving holes in the leaves, as is shown on Plate XV, a. Sometimes the beetles feed on the upper surface of the leaves, but the results are the same. According to Howard,* in most tobacco-growing sections this injury is caused by *Epitrix parvula,* Fabr., which is called the tobacco flea beetle, and which extends from Florida west to Arkansas and northward. In the tobacco fields which we have examined during the past four years flea beetle injury has everywhere been apparent. On collecting the beetles, we were somewhat surprised to find that all were the cucumber flea beetle, *Epitrix cucumeris* Harr. We have never taken a single specimen of *E. parvula* on tobacco in Connecticut. The fact that the cucumber flea beetle attacks tobacco was mentioned by McCarthy as long ago as 1891†; it is not strange, because this species is found upon a great number of plants. Chittenden states ‡ that Mr. Shamel reported, August 11, 1903, that this species was doing much damage at Tariffville, Conn., confining itself to Cuban varieties, and attacking the leaves just before picking. Though it may occasionally cause injury to the mature plants, where it is found chiefly on the lower leaves, it is most common upon small plants, which are sometimes killed, and often greatly damaged by its attack. The lower leaves are injured most, and then in turn the next ones are attacked.

I am glad to be able to state that flea beetle injury can be controlled, as our experiments of the past two years show. Several hundred plants were dipped in arsenate of lead at the time of transplanting, and no flea beetle injury resulted. Though different proportions of the poison were used, one pound in ten gallons of water proved effective, and caused no injury whatever to the plants, even where both roots and leaves were dipped. Poisoned plants were not injured by flea beetles, while untreated plants beside them were severely injured. Where the poison was used in the proportions of one pound in four gallons, the plants were severely injured. As the older

* The Principal Insects Affecting the Tobacco Plant; Yearbook for 1898, U. S. Dept. of Agriculture, p. 123.
† Bulletin 78, No. Carolina Expt. Station, p. 16.
‡ Bulletin 44, Bureau of Entomology, p. 96.

and lower leaves are the ones eaten, this process of dipping at transplanting time fits the case exactly by poisoning those leaves which are subject to attack. Of course plants may be sprayed with an arsenical poison, but it is difficult to apply poison to the under sides of the leaves after they have been set in the field.

In dipping, a pail containing the poison mixture is large enough in which to dip twenty-five, fifty or even one hundred

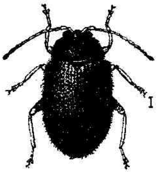



FIG. 9. The cucumber flea beetle *Epitrix cucumeris*. (After Chittenden, Bureau of Entomology, U. S. Department of Agriculture.)

plants, if they are not too large. They can then be set in the ordinary manner.

The cucumber flea beetle is illustrated in Fig. 9.

## GRASSHOPPERS, TREE CRICKETS, ETC.

Tobacco is often eaten by various species of Orthoptera, and sometimes severely damaged. The leaves injured by grasshoppers have holes in them, or perhaps the edges eaten, the holes being larger than those resulting from flea beetle injury, but usually smaller than those eaten by horn worms.

As a rule, the plants of the outside rows and those at the ends of the rows around the margins of the field, especially if adjoining fields of grass, weeds or brush, are injured more than the plants in the center of the field. Certain of these insects make their way to the middle of the field, and there feed upon the plants. For instance, the Carolina locust, *Dissosteira carolina* Linn., the brown species so common everywhere about the fields and roadsides, flies long distances and seems to be one of the worst tobacco depredators of the grasshopper

family. The red-legged grasshopper, *Melanoplus femur-rubrum* DeG., is usually common in the state, and has been observed upon tobacco.

Tree crickets are sometimes injurious, especially around the edges of the field. The commonest one is the four-spotted tree cricket *Œcanthus quadripunctatus* Beut., though the striped tree cricket *Œ. fasciatus* Fitch is also found feeding upon tobacco.

Other species of Orthoptera attacking tobacco in Connecticut are the Texas katydid, *Scudderia texensis* Sans-Pictet; *S. septentrionalis* Serv.; slender meadow grasshopper, *Xiphidium fasciatum* DeG.; and the short-winged meadow grasshopper, *X. brevipenne* Scudd.

As grasshoppers feed on many kinds of plants, we may expect to find any local species feeding upon tobacco plants.

## The Spined Tobacco Bug.

*Euchistus variolarius* P. Beauv.

This insect is one of the Pentatomids or "stink bugs," about one-half an inch long, and varying in color from green to dark brown. In the opinion of many growers this insect is capable

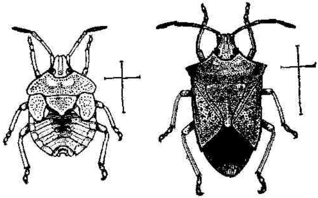


Fig. 10. The spined tobacco bug *Euchistus variolarius*. (After Howard, Bureau of Entomology, U. S. Department of Agriculture.)

of causing serious injury to tobacco by sucking out the sap, causing leaves to wilt. In 1905, several specimens were gathered, placed in a cage with a growing plant in the field, and watched. One of these bugs was seen sucking the sap

from the midrib on the under side near the base of the leaf. The leaf wilted in consequence, and did not recover until the third day, when it gradually assumed its normal condition. Afterward we could not see that the injured leaf was inferior in any way to other leaves, but some of the growers claim such leaves to be of inferior quality and somewhat lacking in size. Garman in Kentucky has observed the injuries caused by this bug, but evidently does not regard them as very serious.* This insect is shown in Figure 10.

## Plant Lice.

Green plant lice were found on the under surface of the large lower leaves of tobacco in a field at Glastonbury, July 27, 1904. The lice were not very abundant anywhere, but were scattered throughout the field. Reports from growers indicate that plant lice are frequently noticed in other sections of the tobacco region, but that almost no damage is done by these insects. In 1898 Mr. T. Pergande of the Bureau of Entomology described *Nectarophora tabaci* † from tobacco in the District of Columbia and Maryland. Howard states ‡ that *N. tabaci* is found near the terminal leaves, while our Connecticut species occurs on the older leaves. Material now at hand does not enable us to decide with certainty whether or not it is identical with *N. tabaci*. There are a number of species of plant lice occurring on solanaceous plants which doubtless may attack tobacco.

Spraying the plants with common laundry soap and water (one pound in eight gallons) should kill those lice hit by the spray.

## White Fly.

Mention should here be made of the greenhouse white fly *Aleyrodes vaporariorum* Westwood. Though this insect has not yet been observed by the writer in tobacco fields, it always attacks tobacco plants grown for experiment upon the station

* Bulletin 66, Kentucky Agr. Expt. Station, p. 33.

† Canadian Entomologist, Vol. XXX, p. 300.

‡ The Principal Insects Affecting the Tobacco Plant; Yearbook for 1898, U. S. Dept. of Agriculture, p. 144 (also Farmers' Bulletin No. 120).

grounds. As this insect has a list of over sixty different plants, and may be carried through the winter on house plants or in the greenhouse, it is extremely probable that sooner or later it will be found in the tobacco fields. Though it may not be sufficiently abundant over large areas to damage the crop, it is reasonably certain to greatly injure many plants in portions of the field, usually nearest the buildings or points where it passes the winter. This white fly would also be able to breed in seed beds, and might be distributed over the fields on the young plants.

The eggs are very minute, and are attached by one end to the leaf. The larvae are nearly white or yellowish, oval in shape, with a fringe of wax tubes around the margin and several long wax tubes on the dorsum. They are attached to the leaf like scale insects. The adults resemble tiny white moths. All stages are found on the under surface of the leaves, and the adults fly about when disturbed. Larvae, pupae and adults are shown on Plate XVI. A more complete account of this insect may be found in the Report of this station for 1902, p. 148.

In Europe another species, *Aleyrodes tabaci* Gennadius, occurs upon tobacco,* but it has not been reported in America.

Spraying the under surface of the leaves with soap and water (one pound in eight gallons) will kill the adults and larvae. Frequent applications should be given in order to destroy those which hatch from the egg after the previous application.

### Other Enemies.

The tarnished plant bug, *Lygus pratensis* Linn., is often found upon tobacco in Connecticut, and is thought to do it more or less injury. Sometimes when first appearing, the blossom buds turn brown at the tips and fail to develop further. This injury is often ascribed to the tarnished plant bug, but we have never found the insect in connection with this injury, and therefore cannot make any definite statement regarding the matter. This insect causes injury to a great many other plants by sucking out the sap, and it would not be strange if it also attacks tobacco.

* Targioni-Tozzetti, Animali ed Insetti del Tobacco, p. 245.

The false bud worm, or boll worm, *Heliothis armiger* Hübn., occurs in Connecticut, being found occasionally on corn, but I have never seen it injuring tobacco. Farther south, however, the caterpillar bores holes into the rolled-up leaves, or buds, and later into the seed pods. Another species, called the true bud worm, *H. rhexia* S. & A., causes a similar injury, but occurs only in the Southern States.

The "suck fly," *Dicyphus minimus* Uhler, and the tobacco leaf miner, or "split worm," *Phthorimæa (Gelechia) operculella* Zell., both attacking tobacco in the South, have not been observed in Connecticut.

The spotted cucumber beetle, *Diabrotica 12-punctata* Fabr., is commonly found upon tobacco in Connecticut, and injures it slightly by eating small holes in the leaves.

Plants in seed beds are sometimes badly eaten by slugs (*Limax campestris* Binney, and allied species), and here arsenical poison can easily be used.

The onion thrips, *Thrips tabaci* Linde, is an enemy of tobacco in Europe, but in this country it is known only as an onion pest. Recently there has appeared in Florida, Georgia and Texas another species of thrips, *Euthrips nicotianae* Hinds, which according to Hooker * does much damage to shade-grown cigar-wrapper tobacco by sucking out the sap from the veins on the upper surface of the leaf, giving the veins and veinlets a whitish color which shows in the cured tobacco, reducing its value fifty per cent. Hooker recommends clean cultivation of the field between crops and spraying the plants twice a week, beginning while they are in the seed beds.

This tobacco thrips has not yet appeared in Connecticut.

In Texas tobacco is injured by an insect known as the tobacco stalk weevil, or "pith worm," *Trichobaris mucorea* Lec., which tunnels in the leaf stalks and in the main stem, often going down into the root. The adult is a curculionid beetle closely allied to the potato stalk weevil, *T. trinotata* Say, but does not occur in Connecticut.

Another insect which may attack tobacco is the "stalk borer" *Papaipema nitela* Guen. It tunnels in the pith of the stems of a great many different kinds of plants, including the tomato,

* Circular No. 68, Bureau of Entomology, U. S. Dept. of Agriculture, 1906.

and while I have not observed it in tobacco, I expect that it may be found therein.

## THE CIGARETTE BEETLE.

Stored tobacco, cigars and cigarettes are frequently attacked by insects and injured to a greater or less extent. The chief depredator is a small beetle of the family *Ptinidae* bearing the

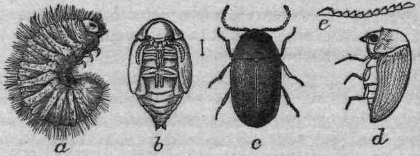



FIG. 11. The cigarette beetle *Lasioderma testaceum*. (After Chittenden, Bureau of Entomology, U. S. Department of Agriculture.)

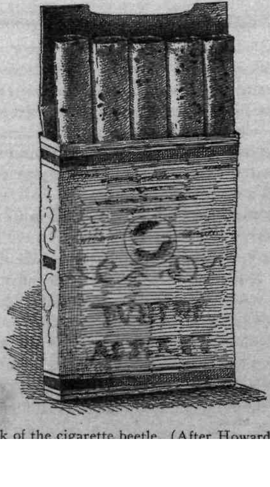


FIG. 12. Work of the cigarette beetle. (After Howard, Bureau of En-

Latin name of *Lasioderma testaceum* Dufts (formerly known as *L. serricorne* Fabr.). This beetle breeds in tobacco and many other dried vegetable products. The adults bore their way out, leaving small round holes. This, of course, ruins cigars and cigarettes, or if leaf tobacco is attacked, it is spoiled for wrapping purposes, and its value diminished. When fine-cut and other smoking and chewing tobaccos are infested, they are injured by a lessening of the amount of the substance, as well as rendering them unsightly. This beetle is shown in Fig. 11, and its work in Fig. 12. Fumigating with carbon bisulphide, or steaming the tobacco, will destroy the insect in all its stages.

Other beetles known to occasionally infest dried tobacco are the drug store beetle, *Sitodrepa panicea* Linn., the leather beetle, *Dermestes vulpinus* Fabr., and the rice weevil, *Calandra oryza* Linn. Remedies are the same as for the cigarette beetle.

## SAN JOSE SCALE SPRAYING EXPERIMENTS IN 1906.

BY W. E. BRITTON AND B. H. WALDEN.

Tests of various mixtures used to kill the San José scale were made at six different places in the state during the fall of 1905 and spring of 1906. Over 600 apple, pear, peach and plum trees altogether were treated, these being situated in Norwalk, Westville, Centerville, Rocky Hill, Berlin, and upon the station grounds. Over 300 peach and plum trees at Berlin were sprayed in the fall (November 22d, 1905) with the lime, sulphur and sodium sulphide mixture. On November 23d and 24th, thirteen peach, pear, apple and plum trees at Westville were sprayed with lime, sulphur and caustic soda.

On March 13th, 106 peach trees at Norwalk were sprayed, about one-third receiving the boiled lime and sulphur wash, one-third, lime, sulphur and caustic soda, and the remaining third, the lime, sulphur and sodium sulphide mixture.

Thirty-nine trees were sprayed the first week in April at Rocky Hill, the mixtures used being the regular boiled lime and sulphur mixture, and the lime, sulphur and sal soda mixture, and "Scalecide" mixed with water in two different proportions.

TABLE I.—EXPERIMENTS AT BERLIN, NOVEMBER 22, 1905.

| Kind of trees. | Number of trees treated. | Condition of trees before treatment. | Materials applied. | Out of 100 Scales on Twigs— Winter killed. | Killed by *treatment.* | Alive after *treatment.* | Percentage efficiency of treatment. |
|---|---|---|---|---|---|---|---|
| Plum | 300 | Badly infested. | 20 lbs. lime.<br>10 lbs. sulphur.<br>10 lbs. sodium sulphide.<br>40 galls. water. | 00 | 95.4 | 4.6 | 95.4 |
| Apple | | | | 00 | 98.2 | 1.8 | 98.2 |
| Pear | | | | .... | .... | .... | .... |
| Peach | | Moderately infested. | | 00 | 98.6 | 1.4 | 98.6 |
| | | Average | | | | | 97.2 |

Four trees (two apple, one peach, and one Japan plum) on the station grounds were sprayed April 7th with "Scalecide" and "Surekill," two proprietary insecticides sold on the market. No twigs were cut to examine the scales previous to applying the fall treatment, because none had then been winter killed.

The exact quantities of the various ingredients used in preparing the spray mixtures, as well as the number and kind of trees treated, and the effectiveness of the mixtures, are given in the accompanying tables.

## Experiments at Berlin.

The tests at Berlin were in the peach, plum, pear and apple orchard of Roy B. Smith. The trees were five or six years of age, had been well cared for, and were in good condition, the majority being only slightly infested. Only a few trees including apple were badly infested, and many showed no scale at all. This small orchard was sprayed thoroughly late in November, while the scale was still breeding, and watched especially to note the effect of the treatment on the fruit buds. A few trees were left untreated as checks, and Mr. Smith states that he could see no difference in quantity or quality of bloom between the sprayed and unsprayed trees. There was no injury to the fruit buds, though this mixture is rather more caustic than the regular boiled lime and sulphur mixture. As shown in Table I, the treatment was fairly efficient in destroying the scale. When examined on January 11th, 1906, two of the apple trees showed many live scales, but considering the badly infested condition of these trees at the time of spraying, the results were as satisfactory as could be expected. A portion of one row of plum trees had many living scales,—suggesting that these trees might not have been thoroughly covered with the mixture. A large proportion of the orchard, however, including peach, pear and plum trees, showed very few live scales. The owner considered the treatment satisfactory.

## Westville Experiments.

A few fruit trees on the grounds of Mr. E. I. Gorham were sprayed with the lime, sulphur, and caustic soda mixture on November 23d and 24th. Some of the trees were badly infested,

TABLE II.—EXPERIMENTS AT WESTVILLE, NOVEMBER 23 AND 24, 1905.

| Kind of trees. | Number of trees treated. | Condition of trees *before* treatment. | *Materials applied.* | Out of 100 Scales on Twigs— | | | Percentage efficiency of treatment. |
|---|---|---|---|---|---|---|---|
| | | | | Winter killed. | Killed by treatment. | Alive after treatment. | |
| Apple | 1 | Medium sized tree moderately infested. | 20 lbs. lime.<br>14 lbs. sulphur.<br>8 lbs. caustic soda.<br>40 galls. water. | 00 | 97.4 | 2.6 | 97.4 |
| Pear | 5 | Large and small trees *badly infested.* | | 00 | 93.7 | 6.3 | 93.7 |
| Peach | 4 | Small trees moderately infested. | | .... | 90 | 10. | 90. |
| Plum | 3 | Small trees moderately infested. | | .... | .... | .... | |
| | 13 | | | | | | |
| | | Average........ | ........ | ........ | 93.7 | 6.3 | 93.7 |

and a slightly larger proportion of scale survived than in the Berlin test, and this, owing to the different conditions, cannot be attributed wholly to the difference in the mixtures applied. Table II gives the statistics of these tests. The final examination showed these trees to be in fairly good condition, and though living scales were found, they were nowhere abundant.

### Experiments at Norwalk.

The trees were a part of the orchard of Comstock & Lyon, and were medium-sized bearing trees which had been headed rather high. Thirty-four were sprayed with a lime, sulphur, and caustic soda mixture, thirty-seven with the lime, sulphur and sodium sulphide mixture, both self-boiled; and thirty-five were treated with the regular boiled mixture. The quantities of materials used in each, and the effect of each in destroying scale, is shown in Table III.

When last examined, on October 29th, the trees were almost free from scale, had borne a good crop of fruit, and were in good condition except for the disease known as "yellows," which had appeared on a few of the trees, and some others had been removed on account of it. The figures in Table III show slightly better results where lime, sulphur and caustic soda was used, but the difference is hardly worth considering, and all of the mixtures proved efficient, and the spraying may be called successful.

### Rocky Hill Experiments.

On April 3d and 4th, spraying tests were made in the orchards of W. F. Griswold at Rocky Hill. "Scalecide" mixed in two different proportions was tested in comparison with the lime-sulphur mixture and the lime, sulphur and sal soda mixture, on apple trees which were generally infested. These trees had been planted five or six years, and were still small enough to be reached easily from the ground by means of extension rods.

In addition to these tests, Mr. Griswold sprayed his young peach orchards of over 10,000 trees with the boiled lime-sulphur mixture.

Table IV gives the principal statistics of the experiments at Rocky Hill.

TABLE III.—EXPERIMENTS AT NORWALK, MARCH 13, 1906.

| Kind of trees. | Number of trees treated. | Condition of trees before treatment. | Materials applied. | Out of 100 Scales on Twigs— | | | Percentage efficiency of treatment. |
|---|---|---|---|---|---|---|---|
| | | | | Winter killed. | Killed by treatment | Alive after treatment. | |
| Peach | 34 | | 20 lbs. lime.<br>14 lbs. sulphur.<br>5 lbs. caustic soda.<br>40 galls. water. | 18.2 | 79.6 | 2.2 | 99.8 |
| Peach | 37 | Medium sized bearing trees rather high headed and thoroughly infested. | 20 lbs. lime.<br>10 lbs. sulphur.<br>10 lbs. sodium sulphide.<br>40 galls. water. | 21.7 | 76.5 | 1.8 | 98.2 |
| Peach | 35 | | 20 lbs. lime.<br>14 lbs. sulphur.<br>40 galls. water. | 20. | 74.5 | 5.5 | 94.5 |
| | 106 | | | | | | |

These trees were examined January 11th. Where the boiled lime and sulphur mixtures and lime-sulphur-sal-soda mixture had been used, but few live scales were found. Traces of both these mixtures showed on the trees. The bark looked clean and healthy. Practically no difference could be seen in the condition of the trees sprayed with these two mixtures.

Many living scales were present on the trees sprayed with both mixtures of "Scalecide." The scales were especially noticeable on the new growth. The bark did not have the bright, clean appearance of that on the trees sprayed with the lime-sulphur mixtures. The figures in the table show very little difference in the results of the four sprays, and but little difference could be seen in the condition of the trees at the time the twigs were cut. The last examination, however, showed a marked difference in favor of the lime and sulphur mixtures.

## New Haven Experiments.

On April 7th, four trees on the station grounds were sprayed. All were moderately infested with San José scale and were sprayed with two kinds of so-called "soluble oils," "Scalecide" and "Surekill." Both materials were diluted, one part with 25 parts (bulk) of water. "Scalecide" was applied as a spray to two apple trees, and "Surekill" was sprayed upon a peach tree and a Japan plum tree.

When twigs were cut and examined in June, the figures obtained were decidedly in favor of the "Scalecide," as Table V shows. This verdict was later confirmed, as the peach and plum tree sprayed with "Surekill" were very badly infested late in the season.

## Experiments at Centerville.

On the farm of Mr. George C. Neal, Centerville, 104 peach and apple trees were sprayed April 11th. Most of these were in a peach orchard from which many trees had been removed on account of injury by scale and winter killing. A large proportion of these were given the boiled lime-sulphur mixture, but two apple trees each were sprayed with "Scalecide" and "Surekill." Ten peach trees which were selected for our spraying tests were not treated because Dr. Clinton wished

TABLE IV.—EXPERIMENTS AT ROCKY HILL, APRIL 3 AND 4, 1906.

| Kind of trees. | Number of trees treated. | Condition of trees before treatment. | Materials applied. | Out of 100 Scales on Twigs— | | | Percentage efficiency of treatment. |
|---|---|---|---|---|---|---|---|
| | | | | Winter killed. | Killed by treatment. | Alive after treatment | |
| Apple | 5 | Generally infested. | 1 gal. "Scalecide." 20 galls. water. | 20.6 | 73.9 | 5.5 | 94.5 |
| Apple | 4 | " " | 1 gal. "Scalecide." 14 galls. water. | 19.5 | 73. | 7.5 | 92.5 |
| Apple | 9 | " " | 20 lbs. lime. 16 lbs. sulphur. 40 galls. water. Boiled 45-60 min. | 22. | 72.4 | 5.6 | 94.4 |
| Apple | 11 | " " | 20 lbs. lime. 16 " sulphur. 10 " sal. soda. 40 galls. water. Hot water used to slake lime. Covered and left for 1 hour. | 17.8 | 75.1 | 7.1 | 92.9 |
| | 39 | | | | | | |

TABLE V.—EXPERIMENTS AT NEW HAVEN, APRIL 7, 1906.

| Kind of trees. | Number of trees treated. | Condition of trees *before* treatment. | Materials applied. | Out of 100 Scales on Twigs— | | | Percentage efficiency of treatment. |
|---|---|---|---|---|---|---|---|
| | | | | Winter killed. | *Killed by* treatment. | *Alive after* treatment. | |
| Apple | 1 | Slightly infested. | 1 gal. "Scalecide." 25 gal. water. | 20 | 79.2 | 0.8 | 99.2 |
| Apple | 1 | " " | | 17 | 78.7 | 4.3 | 95.7 |
| | | Average | | | | | 97.4 |
| Japan Plum | 1 | Slightly infested. | 1 gal. "Surekill." 25 gal. water. | 27 | 50. | 23. | 77. |
| Peach | 1 | " " | | 19 | 60. | 21. | 79. |
| | | Average | | | | | 78. |

TABLE VI.—EXPERIMENTS AT CENTERVILLE, APRIL 11, 1906.

| Kind of trees. | Number of trees treated. | Condition of trees before treatment. | Materials applied. | Out of 100 Scales on Twigs— | | | Percentage efficiency of treatment. |
|---|---|---|---|---|---|---|---|
| | | | | Winter killed. | Killed by treatment. | Alive after treatment. | |
| Peach | 10 | Moderately infested. | Bordeaux mixture.* 4 lbs. lime. 4 lbs. copper sulphate. 45 galls. water. | 23.2 | 47.6 | 29.2 | 70.8 |
| Peach | 90 | " " | 20 lbs. lime. 14 lbs. sulphur. 40 galls. water. Boiled for 45–60 m. | 19.1 | 75.4 | 5.5 | 94.5 |
| Apple | 2 | Badly infested. | 1 gal. "Scalecide." 20 galls. water. | 19.8 | 79.9 | .3 | 99.7 |
| Apple | 2 | " " | 1 gal. "Surekill." 25 galls. water. | 17.5 | 75. | 7.5 | 92.5 |
| | 104 | | | | | | |

* These trees received a second spraying May 23, with weak Bordeaux mixture containing materials in the proportions of 2–2–45.

to make observations on these trees regarding treatment for certain fungous diseases. They were therefore sprayed with Bordeaux mixture, and though this was not a part of our experiment as originally planned, it gave us an opportunity to observe the value of the treatment as a scale destroyer. On May 23d, Dr. Clinton gave these trees another spraying, using half strength Bordeaux mixture, containing two pounds each of lime and copper sulphate to 45 gallons of water. Even two treatments failed to kill three-fourths of the scales, showing it to be comparatively valueless as a scale destroyer.

These trees were examined on December 13th. The trees sprayed with the Bordeaux mixture were badly infested with scales. Trees sprayed with lime and sulphur were quite free from live scales. On the large trees that had been cut back in the spring very few scales could be found on the new growth.

The two apple trees sprayed with "Scalecide" were very thoroughly infested in the spring, and many dead scales were present. In December it required a careful examination to find any living scales.

The trees sprayed with "Surekill" were badly infested with living scales.

*Table* VI contains the records of the spraying tests at Centerville.

TABLE VII.—PERCENTAGE EFFICIENCY OF INSECTICIDES.

| Formula. | Percentage of Efficiency of Insecticides at | | | | | | Average for these localities. |
|---|---|---|---|---|---|---|---|
| | Berlin. | West-ville. | Norwalk. | Rocky Hill. | New Haven. | Center-ville. | |
| Lime, sulphur and sodium sulphide | 97.2 | ---- | 98.2 | ---- | ---- | ---- | 97.7 |
| Lime, sulphur and caustic soda | ---- | 93.7 | 99.8 | ---- | ---- | ---- | 96.7 |
| Lime, sulphur and sal soda | ---- | ---- | ---- | 92.9 | ---- | ---- | 92.9 |
| Boiled lime and sulphur | ---- | ---- | 94.5 | 94.4 | ---- | 94.5 | 94.5 |
| "Scalecide" (1—14) | ---- | ---- | ---- | 92.5 | ---- | ---- | 92.5 |
| " (1—20) | ---- | ---- | ---- | 94.5 | ---- | 99 7 | 97.1 |
| " (1—25) | ---- | ---- | ---- | ---- | 97.4 | -- | 97.4 |
| "Surekill" 1—25 | ---- | ---- | ---- | ---- | 78. | 92.5 | 85.2 |
| 2 sprayings Bordeaux mixture | ---- | ---- | ---- | ---- | ---- | 70.8 | 70.8 |

## Discussion of Results.

The figures showing the percentage of efficiency of insecticides should not be understood as being absolutely exact, because in the ordinary experiments along this line it is not possible to obtain such definite results. In a general way, however, Table VII shows that all of the lime and sulphur mixtures were fairly effective in destroying the scale, whether applied in fall or spring. Probably there is no great difference in these so far as effectiveness is concerned if they are properly made and applied. It is often difficult or impossible to obtain locally a grade of lime that is satisfactory in making a self-boiled mixture. The boiled mixture will usually be more satisfactory than the self-boiled, if it is necessary to use mortar lime or lime which is partially air-slaked. Our experience shows no injury whatever to buds or twigs by the lime and sulphur mixture applied in the fall.

The most frequent cause of failure in spraying work is lack of thoroughness in applying the mixture. It is difficult to cover with the spray every portion of the bark on a tree from the ground to the uppermost twigs, but it is absolutely essential to do this if we would destroy the scale, or clean up infested trees. If any portion of the bark be infested and escape treatment, the work will not be wholly successful.

Table VII also shows that "Scalecide" in the proportions used gave fairly good results as a scale destroyer, while "Sure-kill" was much less satisfactory. Both were used in the proportions recommended by the manufacturers. These materials represent a comparatively new form of scale insecticide, and several other brands are now sold. The basis is petroleum, with heavy and light ingredients removed, and some of them contain certain proportions of resin oil and vegetable oil, the whole treated with caustic soda or some other alkali, to render them miscible with water. While some of these products have given good results and seem to be fairly uniform in composition, they are still in the experimental stage. There is unquestionably a demand for something of the sort to use in treating trees and shrubs in city yards, spraying growing nursery stock, or in the treatment of small orchards, especially where labor is more important than the cost of materials.

In the peach and apple orchards of medium or large size we still recommend the lime and sulphur mixture as being altogether the cheapest, most destructive to the scale, and most beneficial to the trees of anything yet tested in Connecticut.

Though "Scalecide" and other miscible oils show no injury to the trees in a single season, it is too early to say that they produce none. After being used several years we shall know better about it, and it is possible that a cumulative injury may later manifest itself. *But spray with the miscible oils by all means if you can do no better. The injury is certain to be less than that caused by the scale where not checked.*

## NOTES ON FUMIGATING BUILDINGS.

By B. H. Walden.

*Hydrocyanic Acid Gas in a Dwelling House.*

On November 9th the writer fumigated a small six-room house, known to be infested with bedbugs, *Klinophilos lectularia* Linn. The house had just been vacated.

Hydrocyanic acid gas and carbon bisulphide were considered as remedies. To get the best results with the carbon bisulphide, the generators should be placed near the top of the rooms. This is easily done in seed houses and store rooms that are nearly filled, but in the case of an empty house it appeared to be quite a problem to suspend the generators. Carbon bisulphide requires much more generating surface, hence more dishes are needed than with the hydrocyanic acid gas. It was found that the materials for the hydrocyanic acid gas were slightly cheaper than carbon bisulphide purchased in small quantities. For these reasons hydrocyanic acid gas was used.

The house was measured and found to contain a little more than 15,500 cubic feet of space, and as it was planned to use the formula recommended for fumigating nursery stock:—

| | |
|---|---|
| Potassium cyanide 98% | 1 oz. |
| Sulphuric acid 66° Baumé | 2 ozs. |
| Water | 4 " |

36 lbs. of commercial sulphuric acid and 10 lbs. of potassium cyanide, manufactured by Harshaw, Fuller & Goodwin Co.,

warranted 98-99 per cent. were purchased, costing as follows:—

| | | |
|---|---|---|
| 36 lbs. | Sulphuric acid at 4 cts. .......... | $1.44 |
| 10 " | Potassium cyanide at 26 cts. ..... | 2.60 |
| | | $4.04 |

For generators, twelve large earthenware pudding dishes were used, having a diameter of eight inches at the bottom and twelve inches at the top, and about three inches deep. These were supplemented by three smaller granite iron dishes. The amount of cyanide for each room was weighed out and placed in thin paper bags, which were then marked for the room intended. The dishes were then prepared by having the water measured and placed in them and the proper quantity of acid slowly stirred into the water. The generators were placed in the rooms, and a bag of cyanide was placed near each generator.

The cubic contents of each room, the amount of cyanide, and number of generating dishes were as follows:

| | | | |
|---|---|---|---|
| Attic .................. | 2834 cu. ft. | 28 ozs. cyanide | 2 large dishes |
| Upper hall ........... | 527 " " | 5½ " " | 1 " " |
| Front Closet .......... | 238 " " | 2½ " " | * |
| Chamber No. 1........ | 1324 " " | 14 " " | 1 " " |
| " " 2........ | 890 " " | 10 " " | 1 " " |
| " " 3........ | 689 " " | 8 " " | 1 " " |
| Bath room ........... | 323 " " | 4 " " | 1 small " |
| Lower hall and stairway | 765 " " | 7½ " " | 1 large " |
| Front room ........... | 1133 " " | 9 " " | 1 " " |
| Dining room .......... | 1097 " " | 10 " " | 1 " " |
| Kitchen ............... | 1272 " " | 12 " " | 1 " " |
| Pantry ................ | 247 " " | 2½ " " | 1 small " |
| Cellar ................ | 4185 " " | 35 " " | 2 large-1 " " |
| Total ............ | 15.524 " " | 148 " (9 lbs. 4 oz.) | |

No battens were used around the doors and windows, as they all appeared to close tightly. The windows were locked excepting four, which were left unlocked to open from the outside in ventilating the house. The lights were then supposed to be all turned out, and the writer with a lamp giving a strong

* When the cyanide was placed it was found that no dish had been prepared for this closet which opens from the hall, so the cyanide was dropped into the dish which was placed in the hall.

light started at the attic to drop in the bags, coming down through the house leaving all inside doors open, and finishing at the cellar.

The cellar door, which locked only from the inside, had been fitted with a spring lock, so that the operator could pass out and lock the door.

It took nearly two hours to complete the operation, and it was 7:15 P. M. when the house was closed. It was discovered that a gas light had been accidentally left burning in the upper hall. This contiuned to burn until turned out soon after the house was opened at 4:00 P. M. the following afternoon. The house was again closed, and left until about ten o'clock the next forenoon, when it was again opened. There was a strong odor suggesting that considerable gas must have been generated during the night. The generating dishes were then removed, and windows opened in all the rooms. There were traces of the gas remaining at four o'clock P. M. The house was occupied that night, care being taken to have the sleeping rooms well ventilated.

Although it would seem hardly necessary to fumigate more than the floor containing the sleeping rooms, it was decided to fumigate the whole house in order to make the treatment very thorough. The second floor was given a slightly stronger dose than is usually given nursery stock, while in the first floor and cellar smaller quantities were used.

On the day following the fumigation three dead mice were found in the cellar; dead flies and spiders were seen in various parts of the house.

Along one side of the dining room in cracks in the floor, under the baseboard, etc., about thirty dead bugs were found. It was learned that a couch had stood at this place. A few dead bugs were found in one sleeping room. No living bugs have been found anywhere in the house, although it will probably be necessary to wait until another season of warm weather to note the effectiveness of the treatment.

The former tenants spent an average of about fifty cents a month for proprietary remedies against this pest. While these remedies may kill many of the bugs, they serve only as checks to keep them from overrunning the house. These reme-

dies are also very inflammable. The varnish of the baseboards had been injured and wall paper spotted, evidently by some treatment employed.

The hydrocyanic acid gas is perfectly non-inflammable, as is shown in this treatment, and no injury is caused to the most delicate colors or fabrics. It is, of course, a very deadly poison, and great care should be taken in its use. It is especially desirable to use where a house can be vacated for a day or two, but it also can be used in rooms which can be closed very tightly, or which are more or less isolated, while the house is occupied. The gas might be used somewhat stronger, and the rooms closed for only two or three hours.

*Carbon Bisulphide in a Seed Store House.*

A seed store house belonging to the Everett B. Clark Company of Milford was fumigated August 3d under our direction. The seed was infested by the European grain moth, *Tinea granella* Linn., a recently introduced pest, which had not before been reported in Connecticut.

The house was 36 feet long, 22 feet wide and 12 feet high, containing 9,504 cubic feet, and had been used for two years to store seed sweet corn. At the time of fumigating, the house was about two-thirds filled, 2,700 bushels of shelled seed sweet corn being in sacks, and over 1,000 bushels in tightly-headed barrels.

Ten pounds of carbon bisulphide were used. Three milk pans about fifteen inches in diameter and two flower pot saucers from six to eight inches in diameter were used for generating dishes. These dishes were placed on top of the sacks, so that the gas would be evenly distributed. The carbon bisulphide was divided among the dishes, and the house closed for twenty-four hours.

Another store room containing 3,840 cubic feet of space was also fumigated. In this house was stored about 975 bushels of seed sweet corn. Five pounds of carbon bisulphide were used, and the room treated in the same manner as the house which was fumigated. Both houses contained approximately 4,575 bushels of seed sweet corn which cost the owners about $5,700. If no effort had been made to check the pest, there was danger of losing the entire stock.

The place was not visited to note results, but the owners reported that, while some live moths and larvae were found, many of the insects were killed.

Better results would probably have been obtained if more dishes had been used in which to evaporate the carbon bisulphide, and it might be necessary to use more carbon bisulphide to have the gas strong enough to penetrate the bags.

From one to two pounds of carbon bisulphide to each 1,000 cubic feet of space is recommended in a tight room, and there should be at least one square foot of generating surface to each twenty-five square feet of floor space to get the best results. The house or room should be left closed for at least twenty-four hours. Care should be taken not to have any fire around the building, as the gas is inflammable and explosive; and the fumes should not be breathed.

## THE MAPLE LEAF STEM BORER.

*Priophorus acericaulis* MacGillivray

An insect boring in the leaf stems or petioles of the sugar maple, first brought to my attention in 1899, has been studied, with repeated attempts to rear the adults, which were finally obtained in May, 1906. It proved to be a sawfly of the genus *Priophorus* hitherto undescribed, which Dr. MacGillivray has named P. *acericaulis*.* The insect lays eggs in the stem at the base of the blade early in May, and the larva tunnels inside the petiole, leaving only the epidermis, the burrow being filled with castings, and somewhat swollen. The blades break off and fall to the ground the last of May or first of June, but the petioles remain upon the tree for ten days or two weeks, and finally drop to the ground. Either before or after they fall the larva emerges through a hole in the side of the stem, and enters the ground to pupate.

The insect attacks the sugar, Norway and sycamore maples, the sugar maple being by far the most important host. Red and silver maples have been examined from time to time, but have not been found attacked by this insect. I have material from Danbury and New Haven, and have observed its work in

* Canadian Entomologist, Vol. XXXVIII, p. 306, September, 1906.

Stonington. It is also reported from Hamden, Hartford and Southington. Outside of Connecticut it is believed to occur in Canada, New Jersey and Pennsylvania.

Apparently the insect is spreading, and in the most serious cases which have come under my observation nearly one-third of the leaves have fallen about June 1st. We have not experimented with remedies, but the knowledge gained of the life history of this insect prompts us to suggest a spraying of the ground under the infested tree with kerosene emulsion about June 15th, when the larvae are going into the soil. Or if in plowed ground, cultivation of the soil at this time is certain to kill many of them. There should be little difficulty in controlling an insect which is so hard to rear.

A detailed and illustrated account of this insect and its work was prepared by the writer and published in Entomological News, Vol. XVII, page 313, November, 1906.

## IDENTIFICATION OF INSECTS.

During the year 285 samples of insects have been received for identification, and in many cases the specimens were reported as causing injury to plants or animals, and advice was asked regarding treatment. I am indebted to the Bureau of Entomology for identifying several species. A classified list follows:—

## Insects Received for Identification during 1906.

### Orthoptera.

| | | |
|---|---|---|
| *Scudderia sp.* ? | Katydid | Flatbush, N. Y. |
| *Gryllotalpa borealis* Burm. | Northern mole cricket | New Haven. |
| *Œcanthus sp.* | Tree cricket | Stratford. |

### Thysanoptera.

| | | |
|---|---|---|
| *Thrips tabaci* Linde. | Onion thrips | Fairfield. |

### Hemiptera.

| | | |
|---|---|---|
| *Poecilocapsus lineatus* Fabr. | Four-lined leaf bug, 2 samples | Branford, Danbury. |
| *Psylla pyricola* Först. | Pear psylla, 2 samples | Guilford, Concord, Mass. |
| *Aphis pomi* DeG. | Apple aphis, 3 samples | Norwich, North Haven, Hillstown. |
| *Lachnus platanicola* Riley | Sycamore aphis | Philadelphia, Pa. |
| *Phyllaphis fagi* Linn. ? | Beech leaf aphis, 2 samples | Southport, Farmington. |
| *Schizoneura americana* Riley | Woolly elm aphis, 5 samples | Derby, Farmington, Glastonbury, Colebrook, No. Grosvenordale. |
| " *lanigera* Haus. | Woolly apple aphis | New London. |
| *Chermaphis abietis* Linn. | Spruce gall louse, 3 samples | Bristol, So. Woodstock, New Haven. |
| *Phylloxera caryaecaulis* Fitch | Hickory stem gall louse, 2 samples | Hartford, Stockbridge, Mass. |
| *Phenacoccus acericola* King | Woolly maple leaf scale, 6 samples | Bridgeport, West Haven, Danbury, New Britain, Hartford. |
| *Pulvinaria innumerabilis* Rathv. | Cottony maple scale, 2 samples | Branford, Chatham, N. J. |
| *Eulecanium armeniacum* Craw. | Apricot scale | Branford. |
| " *nigrofasciatum* Pergande | Terrapin scale, 2 samples | Deep River, Philadelphia, Pa. |
| " *tulipiferae* Cook | Tulip tree scale, 2 samples | Branford, Greens Farms. |
| *Saissetia hemisphaerica* Targ-Tozz. | Hemispherical scale, 2 samples | Waterbury, Washington. |
| *Chionaspis euonymi* Comst. | Euonymus scale | Middlebury. |
| " *furfura* Fitch. | Scurfy scale, 10 samples | Guilford, Madison, Mt. Carmel, Waterbury, Bethel, Hartford, Warehouse Point, Thompsonville, Danielson. |
| " *pinifoliae* Fitch | Pine leaf scale | Thompson. |
| *Aulacaspis rosae* Bouché | Rose scale | New Haven. |
| *Aspidiotus ancylus* Putnam | Putnam's scale, 2 samples | New Haven, Storrs. |
| " *forbesi* Johns | Cherry scale | Pomeroy, O. |

INSECTS RECEIVED FOR IDENTIFICATION DURING 1906—*Continued.*

| | | |
|---|---|---|
| *Aspidiotus perniciosus* Comst. | San José scale, 43 samples | New Haven, West Haven, Milford, Shelton, Guilford, Norwalk, Westport, Saugatuck, Southport, Waterbury, Naugatuck, Yalesville, Meriden, Bristol, Berlin, Newington, *Hartford*, Glastonbury, Portland, Higganum, Danielson, Norwich, Uncasville, New London, Ivoryton, Concord, Mass. |
| *Lepidosaphes ulmi* Linn. | Oyster shell scale, 10 samples | Milford, Newtown, Westville, *Mt. Carmel*, Durham, Naugatuck, Brookfield Center, Hartford, Putnam. |
| | Plant louse (on *Berberis ilicifolia*) | New Haven. |
| | LEPIDOPTERA. | |
| *Tischeria malifoliella* Clem. | Apple leaf miner | Storrs. |
| *Archips cerasivorana* Fitch? | Cherry leaf roller | New Canaan. |
| *Bucculatrix pomifoliella* Clem. | Apple bucculatrix, 2 samples | Hartford, New Britain. |
| *Oxyptilus periscelidactylus* Fitch. | Grape plume moth | Haddam. |
| *Thyridopteryx ephemeraeformis* Haworth | Bag worm | Philadelphia, Pa. |
| *Malacosoma americana* Harr. | Tent caterpillar, 3 samples | *Southport*, Lisbon, Mystic. |
| *Tolype velleda* Stoll. | | Colchester. |
| *Hemerocampa leucostigma* S. & A. | White-marked tussock moth, 10 samples | Tyler City, Beacon Falls, Cheshire, *Wolcott*, Southington, *New Britain*, Warehouse Point, South Canterbury, Lisbon, Mystic. |
| *Notolophus antiqua* Linn. | Rusty tussock moth, 2 samples | Stafford, Litchfield. |
| *Gluphisia severa* Edw. | | Farmington. |
| *Schizura concinna* S. & A. | Saddle-back caterpillar, 2 samples | New Britain, New London. |
| *Heterocampa* sp. | | New Haven. |
| *Datana integerrima* G. & R. | Walnut caterpillar | East Morris. |
| " *ministra* Dru. | Yellow-necked caterpillar, 2 samples | Hartford, Warehouse Point. |
| " sp. | | New Haven. |
| *Epizeuxis lubricalis* Geyer | | Greenwich. |
| *Erebus odora* Linn. | | Canada. |
| *Catocala cara* Guen. | | Granby. |
| *Macronoctua onusta* Grote? | | New Haven. |
| *Alypia octomaculata* Fabr. | Eight-spotted forester | New Haven. |
| *Halisidota caryae* Harr. | Hickory tussock moth | Colebrook. |
| *Diacrisia virginica* Fabr. | Virgin tiger moth | New Haven. |
| [illegible] S. & A. | Isabella tiger moth, 2 samples | Mystic, New London. |

| | | |
|---|---|---|
| *Hyphantria cunea* Dru. | Fall webworm | Lyme. |
| *Basilona imperialis* Dru. | Imperial moth | Mt. Carmel Center. |
| *Anisota senatoria* S. & A. | Orange-striped oak worm | New Haven. |
| *Automeris io* Fabr. | Io moth, 3 samples | New Haven, Greenwich. |
| *Telea polyphemus* Cram. | American silk worm, 3 samples | New Haven, Bloomfield. |
| *Callosamia promethea* Dru. | Promethea moth, 2 samples | Danielson, Kensington. |
| *Samia cecropia* Linn. | Cecropia moth, 2 samples | Stamford, New Haven. |
| *Smerinthus jamaicensis* Dru. | | Farmington. |
| *Sphinx chersis* Hübn. | | Essex. |
| " *drupiferarum* S. & A. | | East Woodstock. |
| *Phlegethontius sexta* Johan. | Southern tobacco worm | Southington. |
| *Deidamia inscriptum* Harr. | | New Haven. |
| *Sphecodina abbotti* Swains. | Abbot Sphinx, 2 samples | New Haven, Columbia. |
| *Hemaris thysbe* Fabr. | Thysbe clear-wing | Lyme. |
| " *diffinis* Boisd. | | Hartford. |
| *Anosia plexippus* Linn. | Monarch; Milkweed butterfly | New Haven. |
| *Euvanessa antiopa* Linn. | Spiny elm caterpillar, 26 samples, *Mourning-cloak butterfly* | Sound View, West Haven, Madison, Bristol, Farmington, Collinsville. Brookfield Center, Hartford, Buckland, Windsor, Manchester Green, Glastonbury, Haddam, Saybrook, Lyme, New Londen, Taftville, Uncasville, Preston, Mansfield Center, Gilead, No. Grosvenordale, Woodstock. |

DIPTERA.

| | | |
|---|---|---|
| *Cecidomyia liriodendri* O. S. | Tulip tree leaf gall | Branford. |
| *Lasioptera vitis* O. S. | Grape tomato gall | New Haven. |

COLEOPTERA.

| | | |
|---|---|---|
| *Scolytus rugulosus* Ratz. | Fruit bark beetle | Fairfield, |
| *Hylobius pales* Hbst. | | So. Manchester. |
| *Epicauta pennsylvanica* DeG. | Black blister beetle | Guilford. |
| *Coptocycla clavata* Fabr. | | Waterbury. |
| *Dibolia borealis* Chev. | | West Hartford, Wallingford. |
| *Galerucella luteola* Müll. | Elm leaf beetle | North Haven. |
| *Crioceris asparagi* Linn. | Asparagus beetle | Plantsville. |
| *Cyllene pictus* Dru. | Hickory borer, 2 samples | New Haven. |

| | | |
|---|---|---|
| *Prionus laticollis* Dru. | Broad-necked prionus, 3 samples | New Haven. |
| *Euphoria inda* Linn. | Bumble-flower beetle | So. Manchester. |
| *Pelidnota punctata* Linn. | Spotted grape vine beetle | New Haven. |
| *Macrodactylus subspinosus* Fabr. | Rose chafer, 4 samples | Oronoque, Wallingford, New York, N.Y., Marbledale. |
| *Lucanus dama* Thunb. | Stag beetle | New Haven. |
| *Lyctus unipunctatus* Hbst. | Powder post beetle | New Haven. |
| *Podabrus basilaris* Say. | | North Haven. |
| *Limonium griseus* Beauv. | | North Haven. |
| *Melanotus communis* Gyll. | | North Haven. |
| *Anthrenus scrophulariae* Linn. | Carpet beetle | Guilford. |
| *Brachyacantha ursina* Fabr. | | Branford. |
| *Chilocorus bivulnerus* Muls. | Twice-stabbed lady beetle, 3 samples | New Brita n, Uncasville, Rainbow. |
| *Adalia bipunctata* Linn. | Two-spotted lady beetle | Branford. |
| *Megilla fuscilabris* Muls. | Lady beetle | West Hartford. |
| *Agonoderus pallipes* Fabr. | | Wallingford. |
| *Calosoma scrutator* Fabr. | Searcher | Hartford. |

HYMENOPTERA.

| | | |
|---|---|---|
| *Cimbex americana* Leach | Giant sawfly, 2 samples | Bristol, New London. |
| *Eriocampoides limacina* Retz. | Cherry or pear slug | West Hartford. |
| *Strongylogaster pinguis* Norton | 2 samples | New Britain. |
| *Andricus seminator* Harr. | | New Haven. |
| " *palustris* O. S. | | Hartford. |
| *Thalessa atrata* Fabr. | Black long-sting, 3 samples | Norwalk, So. Manchester, Simsbury. |
| " *lunator* Fabr. | Lunate long-sting, 2 samples | Simsbury, So. Manchester. |
| *Apanteles sp.* | | Chester. |
| *Microgaster ?* | | Norwalk. |
| *Isosoma orchidearum ?* | | Thompson. |
| *Vespa crabro* Linn. | Giant hornet | Darien. |
| *Xenoglossa pruinosa* Say. | | Bristol. |

ARACHNIDA.

| | | |
|---|---|---|
| *Tyroglyphus longior* Gerv. | | Winfield, Ont. |
| *Eriophyes quadripes* Shimer | 2 samples | Hartford, Litchfield. |
| " *ulmi* Gar. | | Greenwich. |
| *Tetranychus bicolor* Banks. | 2 samples | Meriden, Marbledale. |

## NOTES.

*Dipping Plants in Arsenate of Lead.* In the last report of this station (1905), page 260, is recorded an experience in dipping plants in arsenate of lead when transplanting. These tests were made primarily to determine the effectiveness of the treatment against cutworms. More extensive tests have been made during the past season. The most concentrated mixture used in 1905 was one pound in ten gallons of water, and no injury resulted even when the roots were dipped. On May 21st and 22d, 1906, tobacco plants at Poquonock and tomato plants at Southington were injured and in some cases killed by dipping in a mixture of one pound of arsenate of lead in 2, 4 and 8 gallons of water, but the transplanting was done at a time of drought and high temperature.

On May 18th, 650 cabbage plants were set on land owned by S. E. Frisbie, Milford, and dipped to see if the treatment would keep out the cabbage maggot. Cabbage leaves and stems are not easy to moisten, as the water gathers in drops and rolls off. By making trials, it was found that soap would overcome this difficulty. A spoonful of soft soap or a piece of hard soap the size of a hickory nut to the pailful will usually serve the purpose. If not, add more soap. The leaves can then be coated with poison, but if the soap is mixed with the arsenate of lead, the latter collects in lumps like curdled milk.

The plat contained 13 rows, and the plants were treated as follows:—

Row 1 (50 plants) untreated.

Rows 2-8 (850 plants) dipped leaves and roots in soap mixture and then in arsenate of lead 1 lb. in 2 gallons water.

Rows 9 and 10 (100 plants) dipped roots and leaves in arsenate of lead 1 lb. in 2 gallons water.

Rows 11-13 (150 plants) untreated.

Owing to the lateness of the season these plants were not troubled by maggot, and Mr. Frisbie harvested over 500 marketable cabbage heads. None of these plants were injured by the treatment.

On May 25th, 500 cabbage plants were set on land leased by the station at Mt. Carmel, one-half the plants being dipped in the mixture of soap and arsenate of lead, the latter at the rate

of one pound in two gallons of water. Later some cauliflower and more cabbage plants were set, and likewise tomato. Some of these were dipped, and others left untreated for checks. Some of the tomatoes were injured by the mixture, especially those set during the drought. In no case did the cabbage or cauliflower plants show injury.

Our experience indicates that this treatment will not wholly prevent injury by cutworms, inasmuch as some eating must be done before the cutworm can get the poison. A few cabbage plants at Mt. Carmel were injured by the maggot, and these were in the check rows. Still more tests must be made, and earlier in the season, before the practice can be recommended as a remedy against the cabbage maggot.

*The Spruce Gall Louse.* For several years Norway spruce trees growing in New Haven have exhibited in early summer curious formations or galls about three-fourths of an inch long and half an inch thick near the ends of the branches at the base of the season's growth. (See Plate XVI.) On examining these galls, we find an opening in the axil of each leaf. These openings are closed on account of the turgid or swollen condition of the tissues, but by bending the twig they can be opened, and small lice-like insects appear inside. There are two broods each year, the nymphs passing the winter at the base of the buds, and becoming mature during the latter part of April. About May 1st the females lay eggs and die. The eggs hatch in about a week, and the nymphs settle at the base of the new shoots, where the galls are formed. After molting three times, the insects develop winged females which emerge through the openings in the galls, and about the middle of August lay eggs covered with a woolly secretion near the tip of a leaf. These eggs hatch in two weeks, and the nymphs are found scattered about over the branches and leaves, until they seek the base of the buds to pass the winter.

This insect has long been known in Europe, but in this country was thought to be a different species, and was first mentioned by Packard* and described provisionally by Thomas†

* Guide to the Study of Insects, p. 523, 1869.
† Eighth Report on Insects of Illinois, p. 156, 1879.

as *Chermes abieticolens.* In Packard's report on forest insects* issued in 1890, this insect is included under the name of *Adelges abieticolens,* Thomas' *Adelges* being a synonym of *Chermes.*

Professor C. H. Fernald, of the Massachusetts Agricultural College, and his assistant, R. A. Cooley, have published† one of the best accounts of this insect which has yet appeared in this country. In order to settle the question of identity, material was submitted to Dr. N. A. Cholodkowski of St. Petersburg, Russia, an authority on this group of insects. From a careful study of material he decided that our species is identical with the European, *C. abietis* Linn. and Thomas' name, therefore, becomes a synonym.

The insect is known to attack Norway, black, white and blue spruces, and the hemlock.

Lochhead‡ and Hopkins§ mentioned the occurrence of this insect in Canada and in West Virginia. Hunter, in his list of the *Aphididae* of North America‖ adopts Maskell's genus *Chermaphis* for this species, but this has not been followed by Felt¶ and others.

Spraying with kerosene emulsion is the remedy commonly recommended for this insect, but it did not prove effective in Professor Fernald's tests in Massachusetts. One pound of whale oil soap dissolved in two gallons of water and sprayed upon the trees in April proved a satisfactory remedy. It is doubtful if any spray would reach the insects in early summer when they are inside the galls.

Some writers advise cutting off and burning the galls during June. The common lace-wing *Chrysopa oculata* Say, and the larva of a syrphid fly feed upon the lice.

*The Asparagus Miner.* On Sept. 20th the asparagus growing on the station grounds was found to be infested by the asparagus miner *Agromyza simplex* Loew. Nearly every stem showed the tunnels. The larva tunnels in the stem near the base and just under the epidermis, working below the surface

* Fifth Report U. S. Entomological Commission, p. 853.
† Report of Mass. Agricultural College, 1898.
‡ Report Ontario Entomological Society, p. 60, 1899.
§ Bulletin 17, N. S. Bureau of Entomology, p. 46, 1898.
‖ Bulletin 60, Iowa Agr. Expt. Station, p. 75, 1901.
¶ *Insects Affecting Park and Woodland Trees*, p. 189, 1905.

of the ground for three or four inches, though sometimes starting several inches or a foot above the ground and working downward. Several larvae are often found in the same stem, sometimes girdling it. The appearance of the infested stems is shown in Fig. 13.

The adult is a small two-winged fly, and the larva can properly be called a maggot. It is not known just how the eggs are laid, but some of the mines start beneath leaf-scales, and as the adult flies are found during the first week in June, the eggs must be deposited at that time. There are two broods each

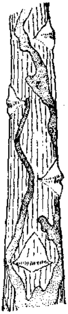


FIG. 13. Work of asparagus miner at base of stem.

season. The pupa stage resembles a flax seed, is always formed in the mines, and the winter is passed in this condition.

It is not certain just how much damage is done by this insect, but the plants are undoubtedly weakened by the attack. It was noticed on the station grounds that the plants which first turned yellow and died were those most seriously attacked. There is little chance to use insecticides in combating this insect, and we can only recommend pulling and burning the infested stalks as soon as they have been killed by frost in autumn. According to Mr. Edmund Halladay this insect has been observed in Suffield and in Massachusetts by Mr. A. D. Shamel of the

U. S. Department of Agriculture. A bulletin by Sirrine,* who has studied this insect on Long Island, is the best account yet published, and from it some of the facts here given were taken.

*Sawfly Larvae Defoliating Peach.* In June, Mr. Barnes of Yalesville reported that insects were at work in his peach orchard, and that the leaves had been eaten the previous year. Mr. Walden visited the orchard, and found a number of sawflies in the trees, which had apparently deposited eggs on the undersides of the leaves near the base of the midveins. Some had hatched, and were eating the leaves. The larvae devoured a narrow section from the edge nearly to the midvein, then rolled one of the free corners inward, making a case in which they remained. A later visit showed some trees quite badly defoliated. The adults were submitted to Dr. A. D. MacGillivray, who pronounced it a new species belonging to the genus *Lyda.* Dr. MacGillivray will soon describe and name this insect.

*European Grain Moth in Connecticut.* Mr. Walden visited the seed storehouses of the Everett B. Clark Company in Milford on August 3d to examine some grain which had become infested with weevils, and to give advice about fumigating the storehouses to destroy them. While several granary pests were present, the chief one seemed to be distinct from anything heretofore observed in this state. On rearing the adult moths, they proved to be the European grain moth *Tinea granella* Linn., a species not before known to occur in Connecticut, though listed from New Jersey. Dr. Howard writes that it is now known to occur in Canada and Michigan, and is probably distributed throughout the Northwestern States.

*Mite on Chestnut Leaves.* Samples of chestnut leaves were received from Meriden and from Marbledale during the latter part of August, which had been attacked by a mite. The upper surface of the leaves had been injured, and the leaves had turned brown as if scorched. The remains of numerous egg shells were to be seen, as well as living mites, upon the

* Bulletin 189, New York Agr. Expt. Station, 1900.

leaves. The same trouble was found on chestnut trees growing on and near the station grounds. Samples were sent to the Bureau of Entomology, and the pest identified as *Tetranychus bicolor* Banks.

*A Sawfly Larva Eating Cherry Leaves.* Some injured cherry leaves from New Britain were received August 4th, with a single dead larva in the box. It was an unfamiliar insect, though the same species was received from Harwinton on August 16th, 1902. On examining the cherry trees at the station, we found a few larva on the leaves, but they were not as abundant as the cherry or pear slug. The species proved to be *Strongylogaster pinguis* Norton. The larva is about one-half inch in length, head black, body dark grey with a light grey stripe along each side.

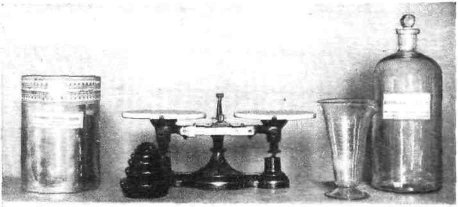
*A Root Borer of Garden Iris.* Several larvae were sent to the station June 30th, with the statement that they were taken from iris, where they were boring in the roots, causing them to decay. The writer being unfamiliar with them, submitted them to the Bureau of Entomology, where they were thought to be *Macronoctua onusta* Grote, but could not be identified with certainty unless the adults were reared. As all were dead and preserved in alcohol when received, it was impossible to obtain the adult stage.

a.—*Inspecting nursery stock. The infested trees are marked by breaking them, and they are afterwards removed.*

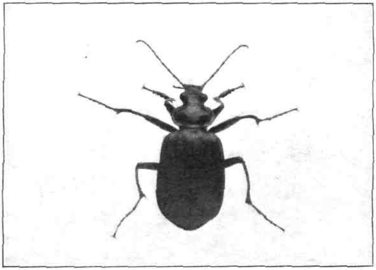
b.—An excellent type of fumigating house, Keney Park, Hartford.

INSPECTION AND FUMIGATION OF NURSERY STOCK.

a.—San José Scale on apple bark. Natural size.

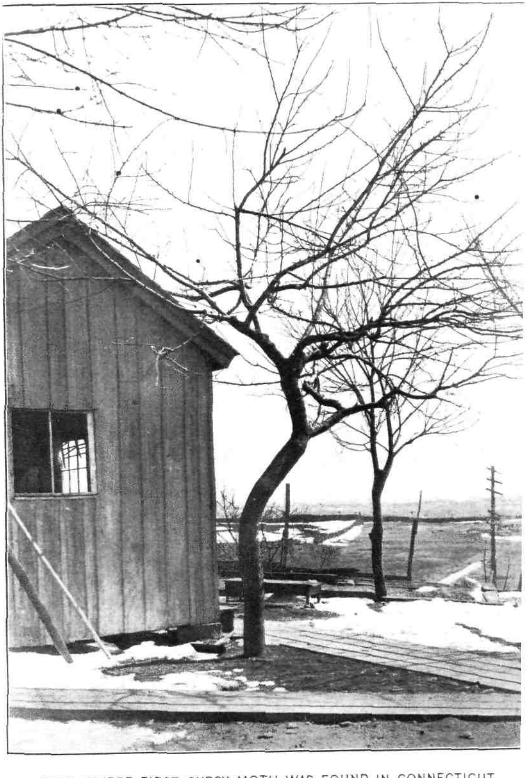


b.—Fumigating utensils.



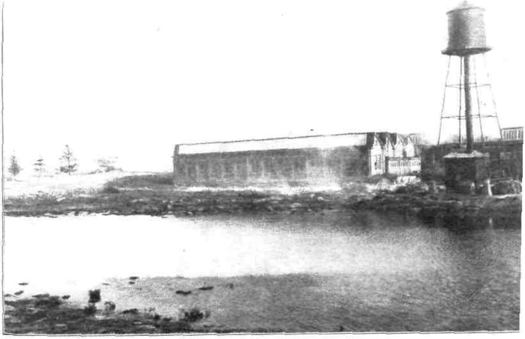
c.—The searcher or caterpillar hunter, *Calosoma scrutator,* natural size.

SAN JOSE SCALE, FUMIGATING UTENSILS AND CATERPILLAR HUNTER.



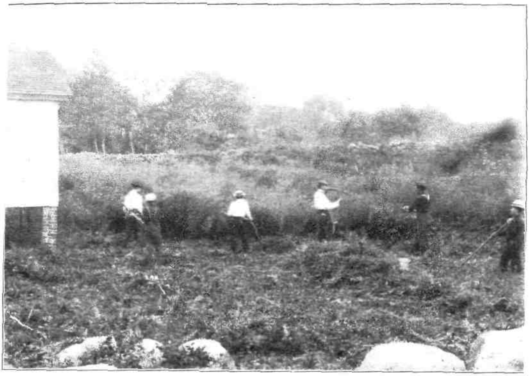
TREE WHERE FIRST GYPSY MOTH WAS FOUND IN CONNECTICUT.

a.—Brush containing egg-masses.



b.—Different view of same area taken while burning brush.

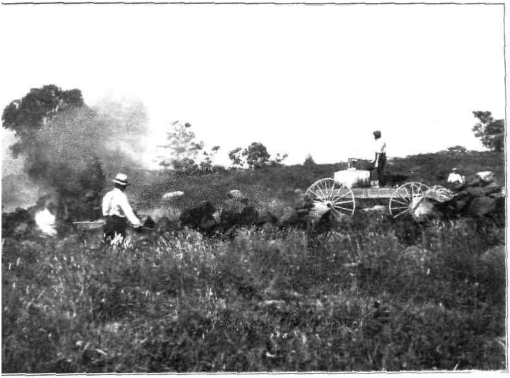
BRUSH NEAR VELVET MILL WHERE EGG-MASSES WERE FOUND.



a.—Cutting weeds and sprouts near velvet mill.

b.—Old cemetery which was entirely hidden by brush.

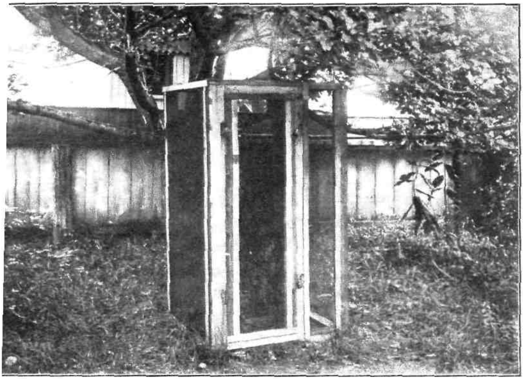
CUTTING BRUSH IN INFESTED AREA.



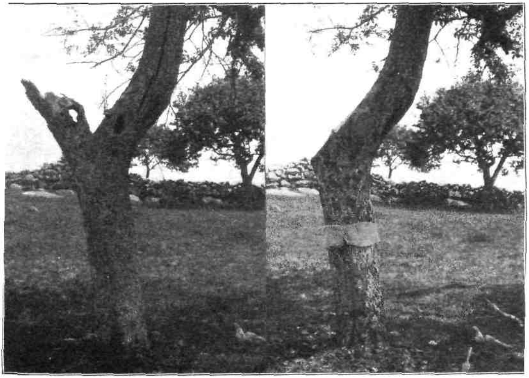
a.—Burning out a stone wall.

b.—Trees marked and banded.

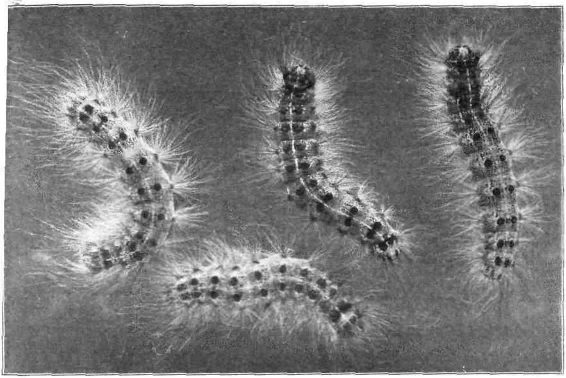
METHODS OF DESTROYING CATERPILLARS.



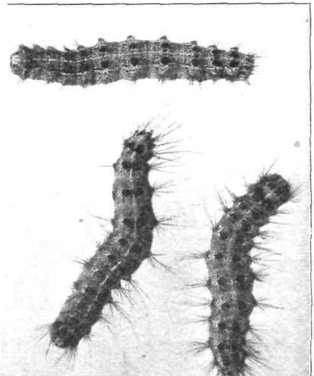
a.—Breeding cage used for obtaining adults.



b.—Appearance of tree before and after pruning, scraping and filling cavities.



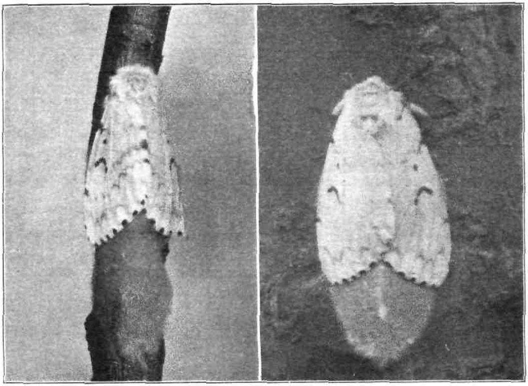
a.—Caterpillars photographed with black background.



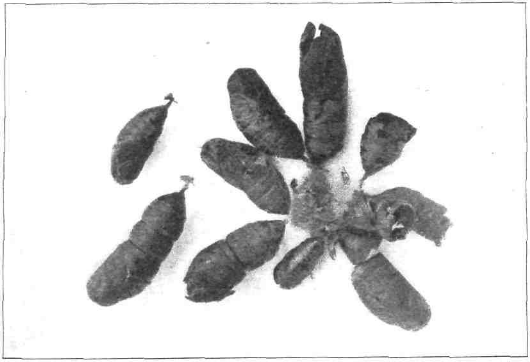
b.—Same caterpillars with light grey background.

c.— Hatched egg-mass showing holes where young caterpillars have emerged.

GYPSY CATERPILLARS AND EMPTY EGG-MASS. Natural size.

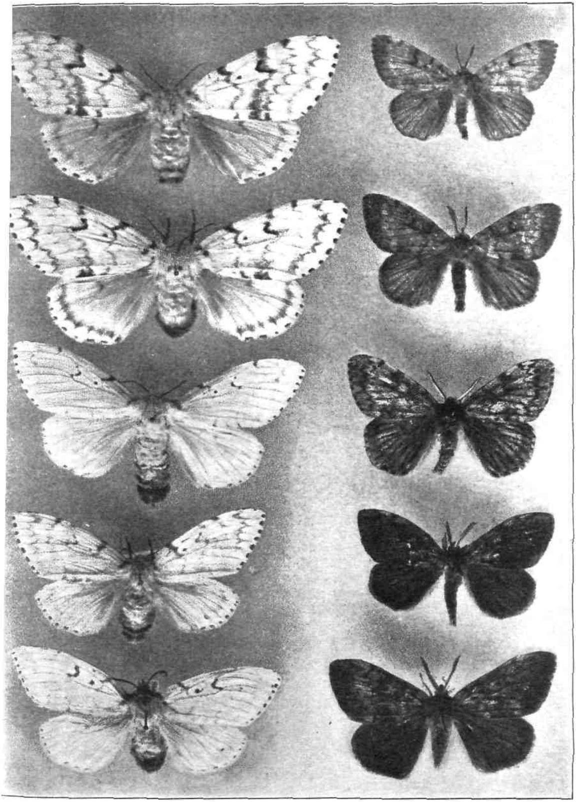


a.—Female moths laying eggs on bark.

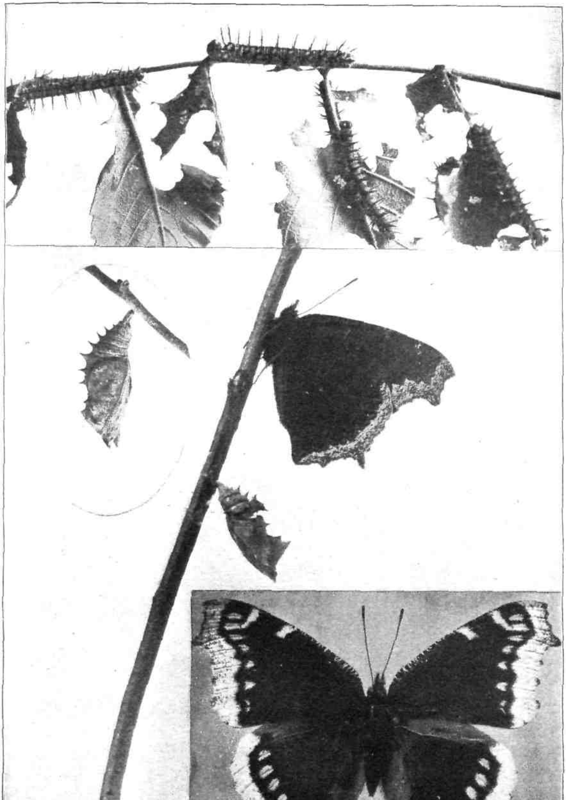


b.—Pupae of gypsy moth.

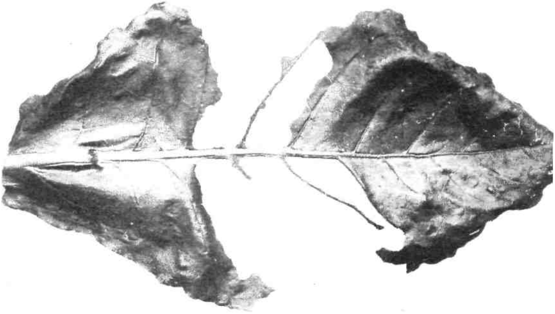
GYPSY MOTH FEMALES, EGG-MASSES AND PUPAE. Natural size.



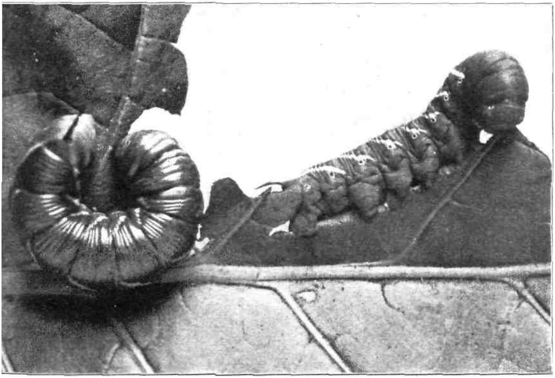
GYPSY MOTH FEMALES AND MALES SHOWING VARIATION. Natural size.



THE SPINY ELM CATERPILLAR OR MOURNING CLOAK BUTTERFLY.
CATERPILLARS, CHRYSALIS AND ADULTS. Natural size.



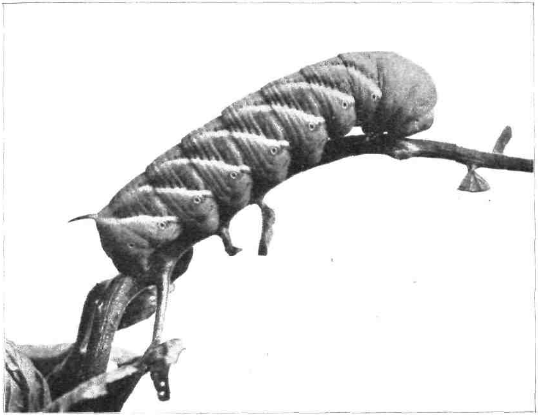
a.—Leaf eaten by tobacco worms.



b.—Tobacco worms. Natural size.

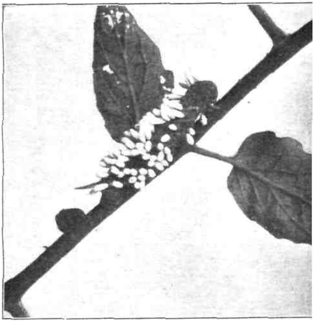
TOBACCO WORMS AND LEAF PARTIALLY DEVOURED.

PLATE XIII.



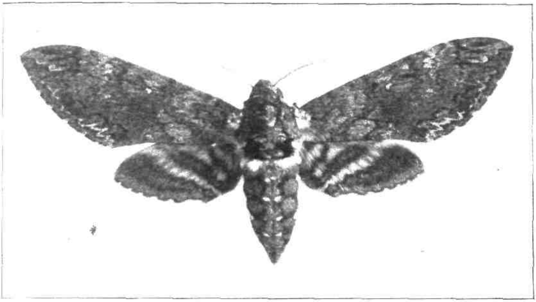
a.—*Southern tobacco worm on tomato.*

b.— Pupae of both species ;howing difference in length of ongue cases. Northern species .t the right.

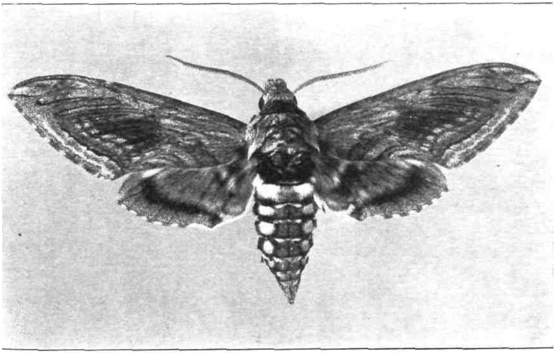


c.—Young tobacco worm bearing cocoons o parasite.

TOBACCO WORMS AND PUPAE. All natural size.

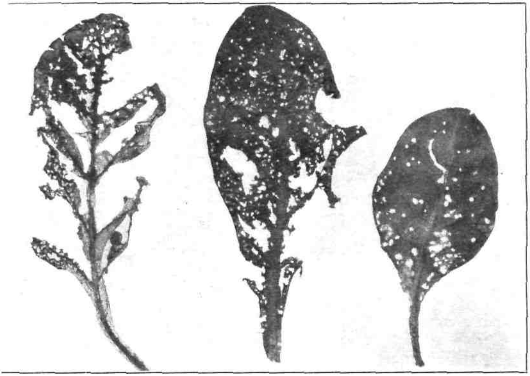


a.—Southern tobacco worm moth *Phlegethontius sexta* Johan.

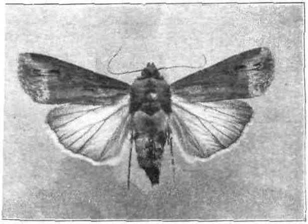


b.—Moth of Northern tobacco worm *Phlegethontius quinquemaculata* Haw.

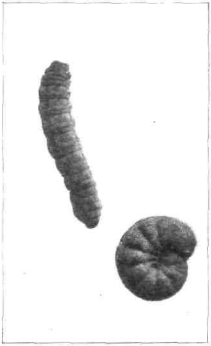
TOBACCO WORM MOTHS. Natural size.



a.—Lower tobacco leaves injured by flea-beetles.



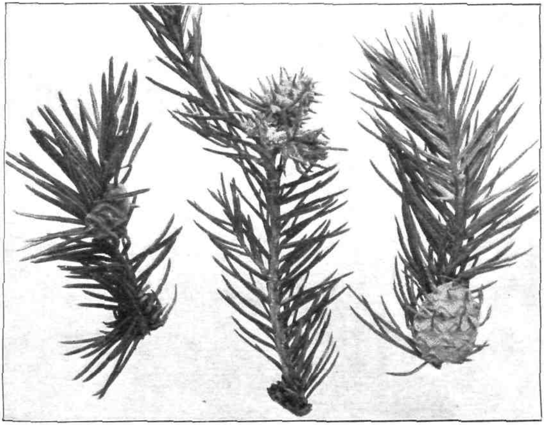
—Moth of the black cutworm. *Natural size.*



c.—The variegated cutworm. Natural size.

TOBACCO CUTWORMS AND WORK OF FLEA-BEETLES.

a.—Adults and pupa skins of white-fly on tobacco leaf. Enlarged four times.



b.—Work of spruce gall louse. Natural size.

WHITE FLY AND SPRUCE GALL LOUSE.

# PART V.

# REPORT OF THE BOTANIST FOR 1906.

G. P. CLINTON, SC.D.

## I. NOTES ON FUNGOUS DISEASES, ETC., FOR 1906.

### GENERAL NOTES ON DISEASES PREVIOUSLY REPORTED.

During the year 1906 fungous diseases as a rule were not especially troublesome in Connecticut. In this respect it was like the preceding year, though the distribution of the moisture was somewhat different. In 1905 the drier part of the growing season came before August, and the moister period was during August and September; but in 1906 the moist weather came in June and July, while the latter part of the season was dry. During last June there was a rainfall of 5.14 inches, which was over two inches in excess of the average rainfall of the past 34 years; July also gave a slight excess over the average. This abundance of moisture was favorable for starting certain fungous troubles, but as it came in thunder showers, without especially cloudy or foggy weather, and as August and September were largely free from rains, the fungous troubles on the whole did not become prominent. A peculiarity of the season, however, was the large number of leaf scorch or similar troubles, due to peculiar weather conditions during June and July.

The diseases mentioned in the following paragraphs are old troubles that were unusually serious or that were less injurious than usual. They are, grouped according to their hosts, as follows:

*Apple.* Sooty blotch, *Phyllachora pomigena,* was very prominent the past fall on apples all over the state. This is now one of the most serious fungous troubles of the apple in Connecticut. While the fungus was especially conspicuous in the small

orchards, and on the few trees kept by each farmer for home use, it also did more injury than usual in the larger orchards, even when they had been sprayed. One could scarcely find any good specimens of Greenings, in the fall and early winter markets, because of blemishes by this superficial parasite. Black rot or canker, *Sphaeropsis Malorum,* was also frequently sent to the Experiment Station for identification.

*Asparagus.* A single grower in Norwalk reported one of his beds seriously injured by the rust, *Puccina Asparagi,* but the writer did not have opportunity for determining whether or not this trouble was common.

*Beans.* The downy mildew of the Lima beans, *Phytophthora Phaseoli,* did some injury, but was probably not quite so injurious as the previous year. A grower in Southport, however, reported a crop practically destroyed by it. The oöspores of this fungus were again found, thus indicating that they are probably not so uncommon as supposed. Anthracnose of string beans, *Colletotrichum Lindemuthianum,* was more common and injurious than for several years.

*Cucumber and muskmelon.* On the whole these plants suffered less than usual from fungous attacks. The growers even had a fair crop of muskmelons. More or less injury, however, was done by the downy mildew, *Peronoplasmopara Cubensis,* and the leaf mold, *Alternaria Brassicae* var. *nigrescens.*

*Grape.* The black rot, *Guignardia Bidwellii,* and possibly other rots, were considerably more injurious than usual. Spraying failed to satisfactorily control this trouble in some cases.

*Onion.* There was considerable complaint of poor onions in 1906. Most of the trouble was due to the character of the season and insects. Fungi were responsible to a less degree in some cases. There seems to be a tendency of onions grown for seed in the onion districts of the state to deteriorate. The cause of this decline, however, is not yet satisfactorily determined, though in some seasons fungous troubles seem to be largely responsible. Onion brittle was more conspicuous this year than last, in the infected fields in the neighborhood of Guilford, since it seems to be a soil trouble that increases in extent each year. A discussion of this disease, including experiments made to control it, is given elsewhere in this report.

*Peach.* While last year there was considerable injury from the brown rot, *Sclerotinia fructigena,* this year the peaches were almost entirely exempt from it. Some little rot appeared at first on the early varieties that are most subject to decay, but the weather as a whole was so fair and dry during the picking season that the crop was conspicuous for its fair size, good quality and freedom from rot.

*Pear and quince.* There were a few complaints of the bacterial blight, *Bacillus amylovorus,* on pear, and one grower informed the writer that he had never seen this trouble so injurious to his quince trees as it was this year.

*Potato.* Tip burn and early blight, *Alternaria Solani,* were more common than usual. The wet weather of June and July came at a time most favorable for the development of the early blight, while the sudden alternation of bright, hot days with those of abundant rainfall was responsible for most of the tip burn, rather than any long period of dry weather. There were some unusual cases of injury to potato leaves in June that were hard to account for except on this basis. The late blight, *Phytophthora infestans,* because of the wet weather of June and July appeared this year considerably earlier than the previous year, the first specimens being found on July 23rd, as compared with August 11th, in 1905. However, the dry weather of August and September prevented the fungus from causing even the ordinary damage. There was a little injury to the foliage of the early potatoes, where the vines grew rankly, and a little rot showed in their tubers; but the injury was soon checked by the dry weather. Although we had unusual opportunity for learning of injury in late potatoes, there was absolutely no complaint of rot anywhere in the state. Without question the late blight did the least damage in the state this season of any of the five years the writer has had it under observation.

*Raspberry.* The wilt of raspberry, *Leptosphaeria Coniothyrium,* which has been complained of in a general way for some years past, was unusually prominent during June and July of the past season, since complaints were received from a number of places scattered over the state of the wilting of the half matured fruit. Further mention of this trouble is made under

new diseases because of a new discovery, concerning its inoculation by insects, which was brought out in our study of the trouble. Aside from the wilt, this was a very good year for raspberries.

*Tobacco.* The early spring seems to have been rather unfavorable for tobacco seed beds, since dampening off and root rot troubles were more conspicuous than usual. The weather for curing tobacco in the barns at the end of the season, however, was so unusually favorable that pole burn did no damage whatever, and the tobacco cured much earlier than usual.

NEW DISEASES.

Each year a certain number of fungi occurring on economic plants are observed that have not been reported previously in this state, or old species are found on new hosts, or some new point is made out in the life history of a fungus. Such data are recorded in the following paragraphs. Some of the fungi briefly mentioned, though of little economic importance at present, may eventually become conspicuous enough for more extended notice later. By recording from time to time these new observations, we aim to have finally a complete survey of all the diseases of cultivated plants of the state. Most of the troubles reported this year are entirely new, special note being made of the exceptions. As usual, we distinguish between those diseases caused by fungi and bacteria, and physiological troubles caused by unfavorable environment (such as heat, moisture, wind, cold, etc.). The common names of the latter class are printed in italics, while those of the former are printed in small caps, followed by the scientific name of the fungus.

**APPLE,** *Pirus Malus.*

*Winter Injury* and CANKER, *Sphaeropsis Malorum* Pk. Plate XVII, a. We have reported before injuries due to the severe cold of winter, and those caused by the canker fungus, but last spring Dr. Britton called to our attention a peculiar trouble of apple limbs that seemed to be due to a combination of these causes. The specimens were from an apple grower of West Hartford, who first noticed the trouble while pruning his trees. The specimens sent to the Station for examination showed large

dead sunken areas in the bark, usually starting from dead twigs, and apparently caused by the canker fungus, since it was in fruiting condition on some of the specimens. Some of the smaller of the injuries had been outgrown by the development of a new growth of bark beneath. Another and more peculiar feature of the trouble was the enlargement of the limbs into somewhat fusiform swellings, as shown in the illustration. In some cases several of the swellings followed one another on the same limb. These enlargements generally showed a greater swelling on one side than on the opposite, and often the bark was split down the more swollen side. Cross and longitudinal sections showed that the swellings were apparently the result of severe cold, which had injured the limbs unevenly along the branch, as shown by the blackened wood on the injured portion. The winter injury was most severe on the side of the limb least swollen, and had restricted the growth of the woody layers the following years, while on the swollen side the wood had made a greater growth, as shown by the larger annual rings. The growth of the bark had been affected, too, by the winter injury, but was thickest on these swellings, and as a rule had made a greater growth on the injured side. The longitudinal cracks in the bark apparently had not been caused by winter injury, but by the abnormal and excessive growth of the wood on the more swollen side of the branch. The cracks only extended through the outer bark, as a healthy growth of new bark beneath was healing them over. Here, then, we have a case of winter injury to limbs acting irregularly (possibly due to unequal maturity of wood at the time of the injury) so that as a whole it stimulated the bark to unusual activity at the injured places, the wood on one side of the limb being so injured as to retard growth the following years, while on the other side the injury was so slight as really to act as a stimulus to unusual growth. The cankered areas occurred on the sides most injured, and apparently the canker fungus largely got a start here through the smaller twigs that had been entirely winter killed.

**BEANS**, *Phaseolus vulgaris.*

*Leaf Scorch.* During the early summer Mr. Andrew Ure of Hamden called the writer's attention to a field of string beans that had been injured suddenly by some cause that rendered

many of the plants worthless. The injury resembled somewhat the bacterial blight of this host, but an examination of the injured tissues failed to reveal bacteria or any fungus as the probable cause. The leaves in some cases were entirely dead, but in others only a part of the leaves were injured. The irregular area of dead tissue of the leaves partially injured was usually separated from the healthy by a reddish purple border, but there was no water-soaked appearance, as is usually the case with the bacterial trouble. Examination failed to reveal any more probable cause than leaf scorch, due to bright, warm weather suddenly following a very violent rain storm, with high winds, which occurred shortly before the trouble was first noticed. A peculiar feature, however, was that some other bean fields in the neighborhood did not suffer from this trouble. This, while difficult to explain, might have been due to the variety of beans, their age, or unknown differences in the soil conditions.

### CARNATION, *Dianthus Caryophyllus.*

SPOT, *Alternaria* sp. This disease was called to the writer's attention by Mr. Walden of this Station, who collected specimens in the greenhouse of Mr. S. Perry Beers of Greenfield Hill. Mr. Beers had obtained his carnations already rooted from another greenhouse, where this trouble was also present. In a few cases the disease was severe enough to kill the plants outright, but usually the injury was limited to the leaves dying at their tips or to the whole top of the plant dying as the result of a girdled area beneath. Generally the injured places were of a whitish color having a rather inconspicuous black growth of the fruiting stage of the fungus. The only mention of a similar disease of carnation caused by Alternaria that the writer has seen is that made by Mr. Orton in the Yearbook of the U. S. Department of Agriculture for 1905 (p. 611). Mr. Woods, of the Department of Agriculture, who has made a special study of the fungus, in a recent letter to the writer says:—

"The disease is quite serious on the softer-leaved varieties, such as those of the Lawson type, especially the Lawson and the Enchantress. The disease behaves very much like the other *Alternaria* diseases, especially the one on the violet, attacking not only the leaves, but the

stems, and cutting the plants back very seriously in many cases. In fact, I have seen whole houses of carnations practically stripped of their leaves and losing a large part of the top. Plants grown out of doors, exposed to rain and dew, especially in the night, are very subject to the disease and suffer seriously when the plants are moved into the house. It is, of course, then rather difficult to free the plants of the disease without cutting them back very severely and spraying them thoroughly with soap Bordeaux. The proper treatment is to spray the plants from the time they are set in the field until the time they are moved into the house, keeping the young growth well covered with Bordeaux and continuing the treatment after the plants are in the house until they become well established. If the plants are grown in the house all of the year and the leaves are not allowed to remain wet over night, the disease seldom, if ever, does much injury."

## CAULIFLOWER, *Brassica oleracea.*

BLACK ROT, *Pseudomonas campestris* (Pammel) Smith. While the black or brown rot of cabbage, turnips and allied plants is not a rare bacterial trouble, it has never been definitely reported in this state. From occasional complaints received from growers, there is little doubt that, while not reported before, it has been present for some time, doing more or less injury. Last October the writer made his first collection of this disease from some cauliflowers grown on the Experiment Station grounds. The heads were blackened and blasted, much as if injured by frost. There was also complaint of a rot of turnips on a Hamden farm which no doubt was also of this nature, though no specimens were seen. The black rot bacteria usually enter their hosts through injured tissue or the water pores at the margin of the leaves. The bacteria develop abundantly in the fibro-vascular vessels, working from the veinlets into the large veins and ribs, which are turned black as a result of the invasion. Finally they may reach the stem, and cause a more general injury. As a result of the clogging and disease of the bundles, the water supply is gradually cut off from the fleshy tissue, and the leaves turn yellow, wilt, and finally die. In diseased cabbage, the bacteria sometimes work their way directly from the infected leaf through adjacent leaves, causing an internal rotting while the head from the outside may appear sound. When this disease appears in a field, rotation with non-cruciferous crops should follow for a few years. The diseased

plants should be destroyed, and rubbish from the plants should never get into the manure pile. It has lately been shown that the bacteria causing this disease can be carried on the seed and cause infection of the young plants, so care should be used to obtain seed from healthy plants.

## CORN, *Zea Mays.*

BLACK MOLD, *Cladosporium Zeae* Pk. This is a fungus that sometimes appears conspicuous on both sweet and field corn, though it is not strictly a parasite, and possibly not directly the cause of any injury. It shows as an olive-black growth on the kernels, usually at the tip of the ears. Apparently it develops on improperly matured or injured kernels, and makes this injury appear more conspicuous. When the seed corn is not properly dried before storage or is left too long stacked in damp places, the fungus probably extends the injury. While Peck described this fungus as a distinct species, it is quite possible that it is not distinct from the common saprophytic black mold, *Cladosporium herbarium* (Pers.) Lk. The renewed interest taken by some of our growers in the selection of seed corn is likely to call their attention to the fungus as one of the blemishes of perfect seed ears, especially of the sweet corn.

## GRAPE, *Vitis* sps.

BITTER ROT, *Glomerella rufomaculans* (Berk.) Spald & von Schr. This fungus has previously been found in this state on the apple and pear, but not until the past season on the grape. On the apple it certainly does not do the damage here that it does further south, and possibly its injury to the grape is also inconspicuous. Just how common the grape bitter rot is in the state, however, cannot be stated at present, as usually all the rots of grapes are indiscriminately called the black rot. This season it was found in one place at Westville, where it seemed to be the cause of considerable decay, and a few berries, chiefly rotting from other causes, were also found among specimens sent from New Haven and New London. The spores ooze out in small pinkish masses, and by these the rot can often be told with the naked eye from the more common black rot.

BLUE MOLD, *Penicillium glaucum* Lk. A trouble which has not been reported before, but which is common, is that caused by the ordinary blue mold found on cold storage grapes, especially towards the end of their season. The fungus attacks the grapes that are more or less bruised by packing or handling; also where the grapes are overripe it seems to gain entrance at their stem end. Along the cracks in the skin the fruiting stage of the mold shows at first as a whitish, but soon as a dusty, blue-green growth. Of course all such berries are worthless, and the spores from these form the means for a much more general spread of the trouble through the basket. While usually but few grapes are injured, if sold soon after removal from cold storage, after they are out some time the trouble may even spoil the whole basket. Some of the baskets offered for sale last fall had as high as a third of the grapes spoiled in this way. Another quite similar blue mold, (*Aspergillus glaucus*) may also at times be partly responsible for this decay, as one of the cultures made from the grapes showed that it was present.

*Shelling* and ROT. One case of serious shelling off of Niagara grapes, about the time of maturity, was reported from New London, and the same variety at the Experiment Station was similarly injured. As in both of these cases the grapes rotted more or less, especially after falling to the ground, it is a question whether or not some fungus might have been partially responsible for the trouble. It is generally conceded, however, that shelling (without rot) is the result of non-parasitic causes. Among the non-parasitic causes the peculiar seasonal conditions of the year, already mentioned elsewhere, which apparently caused an unusual number of physiological troubles, may have been the chief cause of this trouble. The grapes on the ground in time showed the fruiting stage of a species of Macrophoma. This fungus probably occurred on them as a saprophyte; at least *Macrophoma flaccida* (on the fruit) and *Macrophoma rimiseda* (on the branches), which agree somewhat closely with the species reported here, are usually considered non-parasitic species. The shelling of Niagara grapes has been mentioned once before, by Sturgis, in the Experiment Station Report for 1896, p. 278. Since, through oversight, this

was not included among the troubles mentioned by the writer in his general report of diseases, made in 1903, and since it was probably a common trouble the past season, the following is quoted from Sturgis' article:—

"Shelling grapes, at least in the case of green varieties, show a peculiar though indistinct mottling of the surface; the skin is abnormally thick, and the whole berry, therefore, feels harder than healthy berries at the same stage of development; a section of a diseased berry shows a narrow brown zone just beneath the skin; the taste of shelling grapes is noticeably insipid as compared with the tart, astringent flavor of the unripe but healthy fruit; finally, the woody tissues of the stem which enter the fruit and, in the case of sound berries, remain attached to the stem when the berry is pulled off, are so far weakened in the case of shelling grapes that the weight of the berry is sufficient to cause them to separate from the stem, and the berries fall to the ground, leaving the ends of the stem perfectly even, 'as if cut with a knife.' This dropping of the fruit from two to three weeks before maturing, is a characteristic symptom of shelling, and may result in very serious loss, a loss emphasized by the fact that the trouble does not confine itself to certain bunches on a vine, leaving others unaffected, but affects portions, generally the end, of every bunch.

After a most exhaustive consideration of all the possible causes of shelling, Lodeman concludes that neither insects nor fungi are to be considered as a primary cause of the trouble; that the condition of the soil, apart from the supply of available plant food, does not exercise any marked influence on the degree of shelling; that meteorological conditions are not primarily responsible for it; and that it is not due to a lack of phosphoric acid. Among the agencies which may increase or favor the diseased condition, Lodeman mentions parasitic fungi, which weaken the function of the leaves; a weakening of the plant due to overbearing; the drawing of nourishment from the fruit by overproduction of wood; an excessive supply of nitrogen, emphasized by too much tillage; long drought or excessive rains following drought; and a poorly developed root system, resulting in a general weakening of the plant. The condition of the food supply as regards potash seems to be the only remaining factor to be considered, and Lodeman is inclined to attribute the primary cause of shelling to a lack of that element. This view is in a measure substantiated by observation and experiment."

### OATS, *Avena sativa.*

*Yellow Leaf.* This trouble was first seen at Portland, the second week in June. During June and July it was noticed in almost all the oat fields examined, and so must have considerably reduced the yield. The leaves, especially the lower, became

a sickly yellow, and many finally died prematurely. In some respects this trouble resembled the bacterial disease that occasionally occurs in the early summer in the oat fields of the West; but the leaves lacked the water-soaked appearance of that disease, and on examination failed to show any bacteria present. The trouble apparently resulted from unfavorable weather conditions, possibly aggravated by some root disease, though the few examinations made of the roots failed to show any suspicious fungus at work there. June and July had many heavy rain storms suddenly followed by bright hot days, and these sudden changes, as in other cases already mentioned, probably caused the injury. The same trouble was seen to a less degree on a number of other grasses, both wild and cultivated.

### **PEACH,** *Prunus Persica.*

*Leaf Fall.* Another physiological trouble called to the writer's attention by J. H. Hale, of Glastonbury, at the annual meeting of the Connecticut Pomological Society, was the unusual loss of the peach foliage in his orchard during August and September. Many of the leaves turned yellow, finally dying and dropping off. In some cases there was some shot-hole injury, but otherwise nothing to indicate that any fungus or insect was the cause of the defoliation. Conversation with a number of other large peach growers brought out the fact that this defoliation was a common trouble this year in the state. Both bearing and young trees were affected, but certain varieties more than others. Alberta and Late Crawford were among the varieties that suffered most. Some of the growers were inclined to believe that fungi or insects were the cause of the trouble. From their descriptions, however, it seems that neither of these agents, if responsible, was at work on the leaves themselves. The San José scale, if very bad on a tree, may cause partial defoliation, but there was no likelihood that it was unusually prominent in the orchards complained of. It is barely possible that such denudation of the trees might follow root injury. There is no fungus trouble in the state, however, that has been known to act exactly in this way. The crown gall and the crown or foot rot are the only root troubles so far known here, and it does not seem plausible that either

of these was responsible for so general and unusual a trouble. Among the insects the peach borer is the only one that might be suspected, but if this was responsible, it would undoubtedly have been detected by the growers, and its injury is not quite like that described here. Everything considered, it seems probable that this was also one of the seasonal physiological troubles that were unusually common this year. The wet months of June and July no doubt developed a tender and luxuriant leaf growth on the trees, and the bright, dry months of August and September offered such different conditions (especially if the roots still showed any effects of winter injury from the cold winter of 1903-04) that the evaporation of moisture from the leaves became disproportionate to the amount supplied by the roots, and the defoliation of the older leaves gradually followed as a consequence.

## PEONY, *Paeonia* sp.

*Root Injury* or ROT? Plate XVII, b. In September complaint was received from Southington of a root rot of peonies, which had gradually become quite serious. In writing of this trouble, the grower, Mr. H. R. Whitney, said: "When the plants first became established they were very beautiful, but since this disease has come upon them they do not amount to anything, some not even blooming. The first sign noticed is a discoloration of the leaves, turning to a chocolate color, accompanied by wilting, and finally death of the stalk. Sometimes the wilting occurs without any discoloration; the roots seem to rot to pieces at the surface of the ground much after the manner of the rootstock rot of iris (which, by the way, is very prevalent hereabouts; and all our iris beds are seriously affected by it). These peonies were set on a sloping hillside facing the north, and the lowest plants were the first ones affected. The disease has now spread to all. They have always had good care. I am now going to transplant them to higher ground, in fresh soil, and see what this will do."

I am not certain about the cause of this trouble. The specimens sent for examination showed a dry, rather than a wet rot, though possibly this was because they had dried out somewhat. The statement that the iris on his grounds was being

injured by a bacterial rot might indicate that the same agent was at work on the peony. An examination of the roots, however, did not lead the writer to the conclusion that bacteria were responsible for the injury, though some bacteria were present in the tissues, and cultures made from the diseased parts usually gave mixed growths of bacteria and fungi. Microscopic examination of the diseased tissues showed that there was present the sterile mycelium of some fungus that looked as if it might be the cause of the trouble. The fungus was peculiar because of numerous roundish, dark reddish brown chlamydospore-like bodies that occurred in the threads. Cultures from this tissue seem to indicate that these were possibly threads of a Torula developing under unfavorable conditions. In this case the fungus was apparently only a saprophyte that developed in the tissue after the injury, rather than its cause. A peculiarity of the trouble, at least in the specimens sent for examination, was the sharpness with which the healthy tissue was marked off from the diseased, as shown by the lengthwise section of the root in the illustration given here. This may indicate that the trouble was not the result of bacterial or fungous attack, but possibly a winter injury. Usually the injury was on one side of the root, but in some cases it extended up into the interior, with white healthy tissue on either side. Mention of this trouble has not been found in the literature of plant diseases, though probably it has not entirely escaped observation before. Further study of injured plants is needed to determine definitely the cause.

### PINE, *Pinus* sps.

LEAF BLIGHT, *Hypoderma Desmazierii* Duby. This caused the pine needles to die from the tip inward, changing the normal green color to a reddish brown, and in time to a grey brown. On the lighter areas the spore stage of the sac fungus which causes the injury developed as small, longitudinal black lines. The fungus does more or less injury to the large pitch pine trees, *Pinus rigida*, in this state, but just how much is not known. Undoubtedly it causes in time a premature defoliation of the infested leaves. No complaint has been made in this country of the fungus, though in Europe Tubeuf & Smith men-

tion a similar species on white pine as doing considerable injury.

RUST, *Peridermium acicolum* Und. & Earle. During the spring, complaint was received of a fungus injuring the leaves of the pitch pine on an estate at South Manchester. As the owner wished to develop the young native trees into a pitch pine grove for landscape effect, she was anxious that no serious injury be done by this fungus. The writer made a special study of the fungus, with the result that some new features of its life history were brought to light. The fungus forms on the leaves fragile, tongue-shaped, whitish receptacles filled with orange-colored spores. By the first of July these had largely disappeared, as the fungus did not spread further on the pine leaves. It was found that this stage was merely the aecial stage of another rust (*Coleosporium Solidaginis*) that is common on goldenrods and asters. In July, following the disappearance of the rust on the pine leaves, this other rust became very abundant on the leaves of *Solidago rugosa* in this forest, especially where these plants were close to the infected pines. The writer was also able to produce the rust on an indoor specimen of *Solidago rugosa* by infecting it with spores taken from the pine leaves, thus conclusively proving their relationship. The rust at South Manchester appeared chiefly on the young trees six to fifteen feet high, whose limbs in many cases reached the ground. Some few large trees with no limbs near the ground were not at all infected. In order to prevent the spread of the trouble, at the suggestion of the writer, the young trees were trimmed of their lower branches, and the goldenrod, especially under the trees, was all cut off. In this way it was hoped to prevent any large amount of reinfection of the pine leaves from the rust on the goldenrod another season. The writer hopes to make a more detailed account of his study of this fungus elsewhere.

*Winter Injury?* The state forester, Mr. Hawes, recently had called to his attention a trouble of white pine, *Pinus Strobus*, at Windsor. The injured trees were scattered through the forest, and some were of large size, so that their death meant considerable financial loss. The injury first showed in the death of the leaves on the uppermost branches, but gradu-

ally progressed downward until the whole tree was dead. An examination of the injured and dead trees by Mr. Britton, the entomologist, showed that while some were infested with a number of borers, these usually confined their attention to the dead or dying parts of the trunk, and were not species liable to directly cause such injury. The writer saw several badly injured trees (but still possessed of a living trunk and some green leaves) which had blown over, and an examination of these showed in every case that the roots were all dead except a few small and apparently new ones near the surface of the ground. This plainly indicated that the injury was primarily one of the roots. At first we were inclined to believe that the roots had been winter killed, but an examination showed that the mycelium of some hymenomycetous fungus was present in the dead roots and to some extent on the surface of the living. This fungus was not determined, as its fruiting stage was not present at the time of the examination, in March. Of course it is possible that the fungus was present merely as a saprophyte. A similar injury in Massachusetts was recently called to the writer's attention by Professor Stone, who after a thorough study has attributed it to winter injury.

### RASPBERRY, *Rubus* sps.

WILT, *Leptosphaeria Coniothyrium* (Fckl.) Sacc. Plate XVIII, a. This trouble has been mentioned before in the Reports for 1903 and 1904, but this year there were more complaints of serious injury from it than any previous year. A more thorough study of the trouble has developed a new point in its life history. Apparently the very wet weather of June offered favorable conditions for the development of the fungus, as it began to be quite conspicuous in its injury in the fruit about the middle of the month. At this time the disease showed on a few of the young canes, which gradually wilted from the top as if they had been injured below in cultivation. Examination of these showed no such injury, but rather a rot at the base or under the ground apparently due to the wilt fungus, though not in a fruiting condition to fully identify it. Cankered areas (as described by Stewart, of the Geneva, N. Y., Station, who

has made a special study of this trouble) may also occur on various parts of the plant, and by girdling produce a wilt of the parts above. On the fruiting or dead canes, the fungus usually appears more generally distributed in its fruiting condition. From minute imbedded receptacles in the bark large numbers of the spores are shed out on the surface as a dark reddish brown coating. On the pruned canes the fungus often gains entrance through the cut ends, killing the tips and producing its fruiting stage on the dead tissues. The most serious injury shows on the green, but nearly full-grown berries, which begin to wither and dry up about the middle of June. This usually occurs so prominently and suddenly as to alarm the grower, who has not previously noticed the trouble, as indicated by the following letter from Mr. W. B. Eastman of Bethel:—"This A. M. I noticed that many of the berries throughout the entire field were dying. I am afraid that the entire crop will be lost should the dying continue."

The writer had previously had this drying up of the berries called to his attention, and had attributed it to the fungus at work in an obscure way at the base of the plants, or in underground parts, as usually there was no evidence of it on these canes above ground. These plants at Mr. Eastman's were bearing for the first time and showed, as a whole, good vigorous canes except for the wilting of the fruit. There was a little of the wilt fungus present on old stems, and a few new ones were dying from it, but in general there did not seem to be any special reason why the fruit of certain canes should wilt and in other cases not. This, with the fact that the wilting or drying up of the berries started on certain ones of a bunch before it did on others, and a single berry might be dried up on one side while perfectly green and healthy on the other side, suggested that possibly the trouble was not due to a wilting caused by the fungus at work at the base of the canes, but rather was a dry rot due to direct infection of the berries by this fungus. This same idea had been suggested some years before to the writer by a grower whose berries had been thus dried up, but our imperfect examination at that time showed nothing to support the belief. This time, however, it was proved to be correct by a microscopic examination of the diseased and

healthy tissues. In the healthy green tissues no sign of the mycelium of the fungus was found, but in the adjacent diseased tissues it was present more or less prominently. In the berries, for instance, it formed slightly tinted branched threads that worked their way into and between the cells of the fleshy parts of the drupelets, but not into the stony tissue or the embryo. When first infecting the berries, the fungus caused the normal green color to become slightly tinted, as if ripening prematurely; then the tissues gradually turned brown and dried up from the dry rot, which under favorable conditions of moisture advanced through the whole berry, into its receptacle and the calyx, and finally even down into its pedicel, killing the tissues as it advanced. The illustration given in Plate XVIII, a, shows the upper three berries perfectly healthy while those in the lower row are entirely rotted by the fungus except in the center berry, where the fungus had passed down the pedicel only halfway, the lower half being still alive and green, as shown by the lighter color. When going down the pedicels and peduncle, the mycelium penetrates through the parenchyma cells of the bark, kills the young cambium cells, and is also found in the cells of the pith. Just how far down the cells of the stem the mycelium may pass was not noted by later examination of the canes. Certainly it often goes far enough to wilt other berries in the bunch that may have escaped direct inoculation, though in this particular case most of the berries seemed to have been inoculated directly.

While the fungus was not found in fruiting condition on the berries, the search was not continued later than June. Neither did specimens brought into the laboratory and kept for a short time in a moist chamber develop the fruiting stage on the diseased berries, but in one case where a bunch was kept in water for some time, the fungus did finally fruit on the common peduncle. There was no other suspicious fungus in Mr. Eastman's patch, and while this one was not so common in its fruiting condition as seen later in other patches, it was quite common nearby on wild plants along the roadside, whose fruit was suffering from a similar dry rot. There is no doubt in the writer's mind that the infection took place through the flowers and very young fruit, and that the spores were carried by bees

or other insects that had previously crawled over stems coated with the spores.

This wilt seems to be most severe on the blackcap varieties. Among those complained of are the Parmer, Cumberland and Kansas. To a less extent it has injured the red varieties. As stated above, it was also found on wild black raspberries and a few bunches of wild blackberries were seen that possibly may have been suffering from the same trouble. When once the fungus becomes established in a patch, it is apt to give trouble thereafter, and in some instances it has eventually ruined the patch. The few spraying experiments that have been tried have not been very effective. Possibly if the spraying was kept up for two or three years, better results might be expected. It is quite difficult to make Bordeaux mixture stick to the new canes, and this may possibly partially explain the failures. Of course a thorough cutting out of the dead and diseased canes soon after the fruiting season and again in early spring is desirable. It might be well, too, to destroy any wild raspberries in the immediate neighborhood.

### TOBACCO, *Nicotiana Tabacum.*

BED ROT, *Corticium vagum* var. *Solani* Burt. A special study of tobacco diseases the past year has brought to light several fungous troubles that have not been reported before in this state. The Rhizoctonia stage of the above fungus, which is so common on potatoes, has recently been reported by Selby in Ohio as the cause of a bed rot of tobacco. He attributed to it a dampening off of the young plants, and cankered areas on the stems of the larger ones. This trouble is so similar to the one mentioned in our last Report and attributed to a Sclerotinia fungus that we afterward questioned whether it might not be the same. Our much wider examination of tobacco beds the past year, however, seems to show that the Sclerotinia fungus is the common dampening off agent in the tobacco seed beds in this state. We did, however, find the Rhizoctonia fungus present in some of the beds, but so far as observed, its injury was slight, and was confined, as with the potato, to the underground parts. This does not mean that it may not be as serious a pest here as in Ohio, but so far we have not been able to prove

definitely that it was the cause of any serious injury. Since it is so well known as a troublesome soil fungus on various plants, there seems to be no reason why it should not be responsible for some of our tobacco seed bed troubles. That it is the same fungus that occurs on potato was shown where some tobacco plants were left in the beds until about the middle of July, since on these the Corticium or fruiting stage of the fungus formed a white mealy coating at their base just as it does on the potato stems. According to Selby, this fungus is likely to develop most abundantly in an acid soil, so the application of lime to such soils may prove in part a remedial measure. The general treatment for its prevention is the same as that described later under the Stem Rot trouble.

CANKER, *A Bacterial Disease?* Plate XIX, a, b. After tobacco has attained considerable size in the field, say from July on, occasional plants are sometimes found that have the stem girdled underground or a cankered area reaching up a considerable distance on the stem, as shown in the illustrations. In time the bark of the diseased area underground may entirely rot off, and yet the plant above may show the trouble only by a slight dwarfing and a sickly yellowish color of some of the leaves. The canker, when reaching above ground, shows a dark brown sunken area in the bark sharply marked off from its healthy green tissue. This trouble has been known by the growers in this state for a long time, but as it occurs only on an occasional plant, nothing has ever been published concerning it. In our study of the root rot trouble mentioned later, these cankers were noticed, but were believed to be merely an extended injury of the root rot, as in the first specimens examined that fungus was at work on the roots and also somewhat on the underground girdled area. Later experience, however, indicated that this fungus never produces the cankered areas on the stem above ground, at least it was never found there in a fruiting condition. In these places, however, there was a more or less prominent development of bacteria, and while no special study has been made with them, it seems probable that they are the direct agents in extending these cankers. No doubt root rot, stem rot, and even insect injuries, may be the starting point of these cankers. Delacroix of

France has recently described (Recherches sur Quelques Maladies du Tabac en France) a canker trouble of tobacco stems caused by bacteria that possibly may be the same as this.

DAMPENING OFF, *Pythium* sp. Plate XXI, b. This fungus was not found in the regular tobacco beds of the state, though probably it does more or less injury in them, but it occurred on some tobacco seedlings grown in the Experiment Station greenhouse in rich loam. Though quite a different fungus, it dampens off the young plants in much the same way as the stem rot fungus described later, but can generally be told from that trouble by the absence of any white fungous threads creeping over the decayed plants. This fungus (probably *Pythium DeBaryanum* Hesse) is a common dampening off agent of young plants in greenhouses and hotbeds, especially if the soil has been used for some time and contains an abundance of organic matter and moisture. It can be prevented by the same means employed against the stem rot trouble.

ROOT ROT, *Thielavia basicola* (B. & Br.) Zopf. Plates XXIX and XXXI. This was a trouble that was very pronounced in certain tobacco seed beds and fields in the Connecticut valley the past year. While probably not an entirely new disease here, it certainly has not previously attracted the attention it did this year, and has never before been reported by this Station. The injury occurs on the roots, which are often rotted off the young plants. In this respect it differs entirely from the dampening off troubles that rot the stem above the ground. The disease is discussed in detail in a special article in this report, so no further mention need be made of it here.

STEM ROT, *Sclerotinia* sp. Plates XX, a-b, XXI, a. This is the fungus mentioned in our last Report as a "Dampening Off" trouble of tobacco, but as the Pythium fungus described above usually goes by that name, and has now been found here, its name is changed to the Stem Rot trouble. So far as observed, this is the common trouble with tobacco seedlings in Connecticut. Its injury is quite similar to that described by Selby for the bed rot caused by the Rhizoctonia fungus, and both have very similar sterile mycelial threads. Artificial cultures of the stem rot fungus, however, give rise to a pure white mycelium which forms numerous small black sclerotial bodies

that are similar to those of the drop fungus *(Sclerotinia Libertiana)* of lettuce, and apparently quite distinct from the artificial cultures of the Rhizoctonia fungus. Cultures made from diseased plants obtained from the same place in Bridgewater, Conn., both in 1905 and 1906, gave the same fungus, which we have called provisionally Sclerotinia sp. In passing, it might be well to note that Delacroix of France has described a Sclerotinia trouble of tobacco which occurs on the mature plants. Our fungus usually appears in spots in the bed, dampening off all the plants for some distance when they are crowded and the moisture is abundant. Its white threads, visible to the naked eye, form a slight cobweb-like coating on the soil and the base of the plants. When the plants are quite young, the stems just above ground are injured by a wet rot, which causes the plants to fall over, and eventually they are entirely destroyed. Plate XX, a, shows a specimen where the base of the stem just above ground was rotted, while the stem above and the roots below were uninjured. Sometimes the plants are so far advanced that the tissues of the stem resist the attack, with the result that only cankered spots are rotted in the bark, as shown in Plate XX, b, and these may heal over without further injury from the fungus. Such plants are sometimes transplanted by accident in the fields, but they do not usually make a satisfactory development, as they are often broken off at these cankered places, which also offer entrance for other agents of decay.

The stem rot, like other seed bed troubles, is likely to develop in beds in which the plants are too crowded, or kept too moist, either by excessive watering or lack of proper ventilation. Care in these respects, therefore, will often prevent or stop the trouble after it is started, but of course wet, cold springs often make proper regulation of the moisture difficult. When the trouble has been bad in beds for a year or two, it is likely to cause more or less injury each season, and it is then desirable to either change the beds or the soil in them. Beds made in low, wet spots, or which contain abundant organic matter, are likely to be most injured by this trouble.

The writer made a couple of experiments with spraying diseased beds with weak formalin (1 to 1500) to see how this

would work in keeping down further injury from the fungus. Part of a bed at New Milford which was sprinkled twice apparently did not show any improvement over the rest of the bed. In another bed at Bridgewater, part of which was sprinkled three times in June, after the fungus had caused considerable injury, there was apparently some benefit from the treatment. The writer did not see plants from this bed until after they were pulled up, but the owner and his men said that in the treated part the plants rotted less, cankered spots healed over quicker, and the fungus developed less prominently than in the untreated part of the bed. In certain beds at Hockanum, which had been sprinkled several times for the root rot trouble, the owner thought that the treatment had been a benefit. So far as the root rot was concerned, the writer saw nothing to indicate that the treatment had been helpful, but was inclined to believe that possibly some benefit had been derived from lessening the dampening off of the plants. While we cannot state positively from these experiments and observations that sprinkling the beds with weak formalin is valuable in preventing stem rot and similar troubles, it seems well worth a trial in cases where the beds need to be watered more or less. In such cases we would advise the use of weak formalin (the standard 40 per cent. formalin, diluted with water at the rate of 1 to 1500) entirely in the place of water. Such a strength does not seem to injure the tobacco seedlings, and the exposed fungous threads certainly would not develop in this as they would in ordinary water.

Another method of preventing this trouble, when one does not wish to change his bed, is by sterilizing the soil. This may be done either by steam or formalin. The effect of the formalin treatment is shown in Plate XXI, a. In box 1 the soil before sowing the seed was thoroughly soaked with a strength of formalin at the rate of 1 to 100 of water; in box 2 the formalin was half as strong, 1 to 200; and in box 3 the soil was merely soaked with water. These boxes were covered for a day to keep the fumes of the formalin in the soil, and then they were uncovered, aired, and the soil stirred to allow the escape of the formalin. About a week after treatment they were seeded similarly with tobacco. The boxes were covered

part of the time with glass, which kept the air saturated with moisture, and as the plants came up very thickly, the conditions were excellent for the development of dampening off troubles, except where the fungus had been entirely killed in the soil. At first the two treated boxes were much better than the untreated, showing no dampening off, though the plants were crowded, while the dampening off soon developed in several spots in the untreated box. Finally, however, one dampening off spot appeared in box 2, (the weaker treatment, which apparently had not been quite strong enough to entirely kill the fungus), and because of the very crowded condition of the plants at this time, rapidly spread through the box, and even in time passed, at one corner between the glass partition and the wooden side, into the box treated with the stronger solution. The illustration shows the condition of the three sets of plants about four weeks after seeding.

This experiment shows that the dampening off fungi evidently can be largely killed in the soil if the formalin is strong enough and the soaking of the soil is thorough. Based on the results of this experiment, two infected beds were treated late last fall at Bridgewater. In these cases formalin was used at the rate of 1 to 100 of water, and the beds were thoroughly soaked by gradually sprinkling on them a gallon per square foot. The beds were then covered with gunny sacks over night to keep in the fumes. Of course the results of these treatments cannot be determined until later in the season.

### TOMATO, *Lycopersicum esculentum.*

BLACK MOLD, *Fumago vagans* Pers. Plate XVIII, b. We have reported this fungus before on pears and apples, following attacks of plant lice, and also on the linden. During the past year it occurred at the Experiment Station on tomatoes and nasturtiums in the greenhouse and on tobacco outdoors, in each case following an attack of the white fly. On these various hosts the microscopic characters of the fungus were not always the same, as the Cladosporium may or may not be associated with an Alternaria stage, or there may be more or less of a Torula-like growth. For convenience we have called all of the specimens *Fumago vagans*, since this is the species

credited with growing in the honey dew of insects. The most striking development of the fungus this year was on tomatoes grown during the winter in the greenhouse. The white fly confined its attack to the underside of the leaves, while the black mold developed only on the upper side, where it formed a conspicuous olive-black growth, as shown in the illustration. From casual observation one would have supposed that the fungus was really an active parasite developing on the tomato, quite similar to the injurious scab fungus, which often appears on the under surface of the leaves. The black mold in reality did not grow as a parasite, but as a saprophyte in the honey dew secreted by the fly. This honey dew evidently drops on the upper surface of the leaves from the insects on the under surface of the leaves above. This was shown in the case of a tobacco leaf where the leaf had been partly folded on itself, exposing its lower surface above. Here the black mold developed on the exposed lower surface, and on the upper surface except where covered by the fold. It is doubtful if the fungus itself does any injury to the leaf other than shutting off the sunlight, but it does cause an unsightly appearance. There is a possibility, however, that such a fungus, after continued growth on a host in this manner, might become parasitic.

## TURNIP, *Brassica Rapa.*

WHITE SPOT, *Cercosporella albo-maculans* (E. & E.) Sacc. This fungus forms subcircular, greyish spots, showing on both surfaces of the leaves, and varying from an eighth to a quarter of an inch in diameter. When abundant on the leaf it causes prematnre yellowing and death. The disease was observed last September at Kent in a field of turnips, following tobacco, where it was doing some damage. There is some question whether or not this fungus is distinct from *Cercospora Bloxami* B. & Br., and in general appearance it also resembles the leaf spot trouble of horseradish caused by a species of Cercospora.

## VETCH, RUSSIAN, *Vicia villosa.*

LEAF SPOT, *Ascochyta Viciae* Lib. Plate XXII, a. As the Russian vetch has recently been highly recommended as a winter cover crop for tobacco fields in this state, any fungus attacking it becomes of some economic importance. In one

field at Suffield, in October of the past year, some plants of this vetch were observed that were being injured by the above leaf spot fungus. This fungus forms subcircular, greyish spots, with a prominent purplish border. The fruiting receptacles are visible as minute black bodies bedded in the center of the spots, as shown in the illustration. As the leaflets are small only one or two spots generally appear on each, but these are often sufficient to cause their premature death. The fungus has been reported before in this country by Ellis, on the pods of this same host, and also from Canada, on the leaves of a different species of vetch. Saccardo lists *Ascochyta Pisi,* a common fungus of the pea, on the Russian vetch, and as this fungus is very similar to the species reported here, there may be some question as to their distinctness.

### **VIOLET**, *Viola* sps.

SPECK ANTHRACNOSE, *Marsonia Violae* (Pass.) Sacc. Plate XXII, b. We have previously reported a number of leaf diseases of greenhouse violets. The above is one that has rarely been reported in the United States. It was sent from Niantic last fall by Miss Angie M. Ryon, who reported considerable injury to various species of native violets which she was cultivating for scientific purposes. The trouble differs chiefly from the other leaf troubles of violets so far reported in the very small size of the reddish spots, which are usually smaller than a pin head. The spots, however, may become very abundant, being scattered or clustered, and cause a yellowing of the intervening tissues and serious injury to the leaves.

## II. EXPERIMENTS TO PREVENT ONION BRITTLE.

*Nature of injury.* In our last Report we described a peculiar disease of onions, called brittle, that was reported by Burton W. Bishop of Guilford as being a serious trouble in that vicinity when once it became established in a field. Our investigations at that time indicated that the trouble was caused by a soil fungus that worked especially in the roots but whose identity was not fully established. The past season we made some successful experiments to prevent this trouble but gained little further information concerning its cause, partly because of its obscurity but chiefly because this side of the investigation was not especially considered. The general character of the disease is briefly given in the following paragraph, but a somewhat fuller account may be found on pages 270-3 of the Experiment Station Report for 1905.

The trouble usually starts in some small section of a field and each year extends out further, so that the land eventually becomes of little value for growing onions. Weeds in the infected area also do poorly. In some respects the trouble resembles an acid soil, and yet this could hardly explain the spreading of the trouble or the benefit that resulted from the use of certain soil fungicides. While apparently caused by a fungus, this is never evident externally on the roots and often it does not seem abundant enough within their tissues to cause so prominent an injury. Though not definitely determined by actual observation, apparently many of the very young seedlings are dampened off or killed outright, since the stand in the infected area is usually very poor and irregular. In fact most of the injury seems to be to the seedlings, though the older plants do not entirely recover from the backset they received. The infected plants are much smaller than the healthy ones near them or those in the part of the field free from the disease, as is shown in Plate XXIII, a. Another peculiarity is the brittleness of the leaves, from which the trouble takes its name. Very often the leaves are quite irregular or have peculiar spiral coils as shown in *b* of this same plate. The onions may also have a sickly yellowish green color, especially in spots, instead of the normal dark green.

PREVENTIVE EXPERIMENTS.

*Nature of experiments.* Through the courtesy of Mr. Bishop, one end of his field was used in 1906 for experiments in preventing the onion brittle. The disease showed first in this field two years before and when seen by the writer in 1905 had infected an irregular area in one corner about two or three rods each way. In 1906 this infected spot had greatly extended itself, in one direction spreading nearly across the field, though tapering out toward the further end. The character of the infected area is shown in Plate XXIV, a, which slightly exaggerates the injury to the onions in 1906 since some plants did come up on the vacant place, but these were so few and scattered that they were finally plowed up as worthless.

As the trouble is in the soil and injures the plants chiefly while young, the treatments were made with this in view. In the corner of the field where the trouble first showed, the ends of one to seven rows (each 53 feet long and 14 inches apart and so representing about one seven-hundredths of an acre) were used for each treatment. The first set of treatments, made at the time of seeding, April 20, was as follows:

| *Plot.* | *No. Rows.* | *Treatment.* |
|---|---|---|
| 1...... | 6 (1-6)..... | Check ; no treatment. |
| 2...... | 4 (7-10).... | Formalin (1 to 240 water) at rate of 525 gals. per acre. |
| 3...... | 1 (11) ..... | Limoid at rate of 700 lbs. per acre. |
| 4...... | 7 (12-18)... | Sulphur and limoid (2 to 1) at rate 200 lbs. per acre. |
| 5...... | 7 (19-25)... | Complete fertilizer (1 sol. bone black, 1 mur. pot., 2½ sod. nitr.) at rate of 650 lbs. per acre. |
| 6...... | ∞ (26-∞).. | Check ; no treatment. |

In each case after the seed was sown the fungicide was sprinkled or scattered over it and the adjacent earth before covering. In this way the rates used were much more effective than if the fungicides were scattered broadcast. The fertilizer was scattered directly over the rows after the seed was covered. This complete fertilizer was used partly to determine if the land was lacking in fertility but chiefly to see if, with quickly available food, the young plants could be forced to a rapid development and so outgrow or escape the injurious action of the fungus which seems to attack the plants most injuriously while quite small. The land, however, had already been well fertilized, since Mr. Bishop used at about the rate of 9 tons

of salt hay, ½ ton fish scrap and 3 tons wood ashes per acre. He used the salt hay, partly composed of sea weed, to get more humus in the soil and because he thought that the salt might have some influence in checking the brittle.

On June 9th, after the plants had made considerable growth, a second set of experiments (similar lengths of two rows in each case) was made to determine if the treatments would have any effect in stopping or lessening the trouble after it once showed in the plants. These treatments were with limoid (700 lbs. per acre), ground fresh lime (700 lbs. per acre), air slaked lime (700 lbs. per acre), fresh lime slaked in water (½ lb. to 2 gals. water used at rate 1400 gals. per acre), and formalin (1 to 1500 water in two applications at rate each of 1400 gals. per acre). These rows all showed at this time considerable injury from the brittle, especially in the poor stand.

*Results of experiments.* The onions in the second set of experiments (those treated after the plants showed the disease) in no case at any time showed any very appreciable benefit from the treatments. This indicates that the injury to the onions is caused primarily while they are quite small, or at least that this is the time of infection, and so any treatment to be effective must be made at the time of seeding.

In the first set of treatments, made at the time of seeding, the effect was quite evident soon after the plants appeared above ground. The first examination by the writer, made on June 4, showed that the stand and size of the plants were much better in all of the plots treated with formalin, limoid, sulphur and limoid than in the untreated plots and were practically the same as the plants in the best parts of the uninfected portion of the field. The weeds, too, which had been left for observation, were much more numerous and thrifty in these treated plots than in the untreated. The relative size of the diseased and healthy plants at this time is shown in Plate XXIII, a. The plot on which the complete fertilizer had been placed was not any better than the worst of the infected rows that had not been treated at all. This showed plainly that the trouble was in no way due to an impoverished soil or that the young plants could be stimulated in growth to escape the trouble. Of the check plots, No. 1, which was on the very edge of the field, was much better than No. 6, which made such a poor stand

that the onions were worthless. Check plot No. 1, however, was not as good as any of the treated rows, but was considerably better than the plot with the complete fertilizer.

On July 12 the second examination was made and about the same relative condition of the plots was found. The striking difference between the treated plots (limoid, sulphur and limoid, and formalin) and the untreated plots (complete fertilizer and check plot) is shown in Plate XXIV, b. This photograph shows chiefly the sulphur and limoid and the complete fertilizer plots and it brings out the sharp differentiation in size and number of plants even in their two adjacent rows. A more detailed view of the treated and untreated plants is given in Plate XXV. In *a* is shown plants in the complete fertilizer plot while in *b*, photographed at the same time and size, is shown a row each in the sulphur and $limoid_4$, $limoid_3$, and $formalin_2$ plots.

The crop was harvested on Sept. 7, when the number and weight of the onions in each plot was determined. As a whole the season was very unfavorable for onions, so that the difference in yield due to the treatment, possibly, was not so great as it would have been in a more favorable season. The treated plots gave practically the same yield as the uninfected part of the field. Mr. Bishop considers 400 bushels per acre a good yield for this field during a favorable season, but this year only about half this was obtained. The following table gives the details of the yields in the different plots.

| Plot. | Treatment. | Yield of Onions. No. | Yield of Onions. Lbs. | Average per row 53 ft. No. | Average per row 53 ft. Lbs. | Av. per acre. Bu. |
|---|---|---|---|---|---|---|
| 1 | Check | 920 | 54½ | 153 | 9 | 121 |
| 2 | Formalin | 1161 | 60¾ | 290 | 15⅛ | 205 |
| 3 | Limoid | 268 | 15 | 268 | 15 | 202 |
| 4 | Sulphur and limoid | 2072 | 99½ | 296 | 14¼ | 191 |
| 5 | Complete fertilizer (check) | | | 35 | 1⅛ | 15 |

The complete fertilizer plot, No. 5, and the check plot, No. 6, were both practically alike and so poor as to be worthless; so the yield from the single row given here probably represents about an average for these and the worst part of the infected field. It is readily seen from this table that the treatments considerably increased the yield over the best of the untreated rows and as the larger part of the infected area was similar to plot 5 the increase in reality was very considerable.

## III. DRY ROT FUNGUS,

### *Merulius lacrymans* (Wulf.) Schum.

*Timber-destroying fungi in general.* Both parasitic and saprophytic fungi cause injury to our commercial forest trees, the former doing damage to the living trees, and the latter producing decay of their wood after they have died from various causes. Apparently the financial loss caused by the latter class is much greater than that of the former. Such fungous injuries in this country have been studied extensively by von Schrenk of the United States Department of Agriculture, who has issued several bulletins dealing with special troubles of certain kinds of timber trees and their lumber. Popular articles upon fungous injuries to trees have also been written from time to time by other American botanists. Most of the injuries to trees by fungi are caused by certain species belonging to a group known technically as the Hymenomycetes, of which the toadstools and shelf fungi are familiar examples.

In the present article we discuss an injury, caused by one of these fungi, to the timber after it had been placed in a building. This dry rot, or house fungus, is peculiar in that it is what might be called a domesticated fungus; that is, it rarely, if ever, causes rot of the trees in the forests.* Mention has been made in this country of slight injuries caused by this fungus to the woodwork of cellars, greenhouses, etc., where the moisture had been favorable for its development, and short popular articles concerning the fungus itself have been written by MacBride, Freeman and Atkinson; but the writer has found no extended notice of serious injury caused by it. Mr. A. B. Seymour, in a recent letter, writes that some years ago he examined the rafters of a noted old church in Boston, and found them considerably injured by dry rot, which, however, was then entirely inactive. He also wrote that he was informed

* Appel (Arb. K. Biol. Anst. Land. Forstw. 5: 204-6. 1906) recently tried to infect seedlings of fir and pine, grown in pots in the greenhouse, by introducing the mycelium through wounds in the stems; and while he did obtain a growth of *Merulius lacrymans* this in no way seemed to be parasitic on the trees.

that the house at Cambridge in which Oliver Wendell Holmes was born was so injured by dry rot that it could not be moved, and so had to be torn down to make way for the Hemenway Gymnasium. In Europe, however, where the literature relating to this fungus is more extensive, serious injury to buildings has been reported a number of times. The specific case described in this article is of injury to North Carolina pine in the basement of a church, and was called to the writer's attention the past summer by ex-Senator William J. Clark of Stony Creek. The writer made several trips to Stony Creek to observe the fungus and its injury, and is indebted to Mr. Clark for information concerning its first appearance, etc.

INJURY BY DRY ROT FUNGUS TO WOODWORK OF A CHURCH.

*General situation.* The trouble was called to our attention about the middle of June, the first examination being made the 29th of that month. This stone church was comparatively new, and a corner of the basement had recently been partitioned off for a Sunday school room. The entrance to this room and the basement was from a tower vestibule above, that also led into the main auditorium. The steps leading down to the Sunday school room were enclosed in a narrow passageway. It was under these steps, close to the entrance of the Sunday school room, that the trouble was first noticed in an inconspicuous way, some months previous to our visit, through the rotting of a few of the boards. These boards had been replaced, and nothing more was seen of the trouble until after the furnace fire was discontinued in the spring. The walls of the Sunday school room are formed on two sides by the stone foundations of the church, and on the other two sides by a board partition separating it from the remainder of the basement, which is used as a furnace and fuel room. The Sunday school room was plastered to the floor directly on the stone on two sides, and on lath on the other two sides. The baseboard and wainscoting, of North Carolina pine in natural finish, covered the plastering to a height of three or four feet all around the room. The back of the board partitions on the furnace side of the basement was sealed tight by unpainted boards. The steps lead into the Sunday school room at one corner; beneath these is a small

dark closet opening into this room, and nearby in the wooden partition a pair of swinging doors leading into the furnace room. It was in this corner (see Plate XXVI) under the steps (where the trouble originally showed) and in the closet that the fungus started with renewed vigor in the spring. At the time of our visit, a month or two after the first signs of its renewed attack were noticed, it had spread on one side along the wooden partition, past the swinging doors, for a distance of about fifteen feet; but on the other side of the steps, along the stone wall, only a very short distance. Only one or two small isolated outbreaks were found elsewhere, showing on the furnace room side on a sill that rested on the damp earth. Fortunately the floor of the Sunday school was cement, for no doubt if wooden the fungus would have found a very favorable condition for its development beneath it. The furnace room had no floor, but contained piles of old boards for fuel, and in a number of cases where the boards rested directly on the damp ground, there was a slight development of the fungus.

*Conditions favoring development.* In Europe there have been cases where this trouble developed in buildings apparently because the wood used in their construction was already infected with the fungus. In the present instance however, this does not appear to have been the case, for apparently the fungus started from infected old boards in or under the steps, and afterwards spread to the new lumber because of the very favorable conditions for its development. While this is called the dry rot fungus, it really requires moisture for its development, which was very thoroughly provided in the present instance. During the winter, while the furnace was going, the fungus gave no evidence of its development, if present between the wainscoting and the plastering. After the ordinary damp spring months came an unusually wet June, with very frequent heavy rain storms. These, together with the situation of the church on a rock close to the Sound, made the moisture very evident in the basement. Then, too, the basement was cool, and so tended to condense moisture from the saturated atmosphere on the woodwork. The leaders on this side of the church did not carry the water away from the foundation, and on the other side there was no eave trough. This made the ground around the basement Sunday school room very wet

during the frequent rains. The effect of the abundant moisture was shown by the warping of the wainscoting even where there was no sign of the fungus at work. The fact that the plastering extended down to the floor under the wainscoting and that the back was sealed up was also most favorable for the development of the fungus along the wooden partition, since here was an enclosure that prevented its damp atmosphere from readily drying out during the dry weather. Lastly, the slight space between the back of the wainscoting and the plastering furnished a most admirable place for the rapid development of the fungus along the wall.

*Character of the fungous growth.* The fungus consists of three parts: (a) the mycelium, which penetrates into the tissues of the wood, and causes its decay; (b) sterile mycelial strands that develop on the surface of the boards, on the protected side, and serve as a means for rapidly spreading the fungus from one point to another; and (c) the fruiting stage, formed by a luxuriant development of fertile hyphae into special bodies bearing the spores, or reproductive bodies, on their surface. The mycelium consists of branched microscopic threads that penetrate into the wood between and into the cells, and, according to Hartig, dissolve out the coniferin and cellulose of their walls, which causes the cells to become very fragile. In fact, in time the wood may crack up into little areas as it dries out, and eventually is easily crushed into a fine powder between the fingers. The mycelial strands are usually in the shape of a flat mat, with meshes of irregular size and shape (see Plate XXVII, b). Where the fungus showed prominently on the exterior of the woodwork, these flat strands thickly covered the under side of the boards and even the plastering, as shown in Plate XXVII, a. They have a greyish color, and a growing margin of a whitish, fluffy texture, as shown on the wall in the same illustration. In some cases, especially on the ground, or where the conditions for growth were limited, the sterile mycelium, instead of forming a mat, took the shape of cords or strands, and these often grew for a considerable distance. Such strands, by creeping through obscure or inaccessible places, under the sills, etc., offer a very dangerous means for spreading the fungus to other portions of the building. When the moisture conditions of the room became favor-

able during the very wet weather of June, the fungus began to show its presence by emerging between the boards of the wainscoting and around the woodwork of the closet and the swinging door, and developing its fruiting stage. This outgrowth was quite conspicuous, and appeared very rapidly (see Plate XXVI). The growth at first was a fluffy mat of the white mycelium, which, after appearing in the cracks, spread out on either side for an inch or two in width and for a much longer distance along the crack. While these immature fruiting mats when fresh were an inch thick, when dried out they became quite thin and leathery. At first they were white, and without folds; but soon they began to turn a reddish brown, due in part to the formation of the colored spores. Where they had a chance to fully mature, their surface became sculptured with irregular folds or corrugations, or sometimes with flat, tooth-like projections, after the usual manner of the fructification of the genus. Plate XXVIII shows at *a* some of the immature fruiting bodies on a piece of the wainscoting, while at *b* the mature fruiting bodies are shown.

*Damage caused.* The rapidity with which the fruiting stage of the fungus developed during the favorable weather of June is shown in Plate XXVI. The growth as shown in *a* had all been scraped off a week or so before this photograph was taken, while *b* shows the condition just twelve days after the first photograph was made. The fungus was so prominent at this time, and its injury so great, that the trustees of the church decided to remove all the infected woodwork. Many of the boards of the wainscoting were very badly rotted, while others were so badly infected that it was only a question of time before they would be in the same condition. There was danger, too, of the fungus spreading to the remainder of the woodwork, and even above into the church proper. European writers mention cases where the fungus, starting in a wet basement, has spread up into the second story even when that part of the building was dry. The fungus can do this easily by means of its long sterile strands, which also carry food and moisture for its development. Often this moisture is given off, and wets surrounding objects, as the plastering in the present case in one place well up on the wall. On account of this characteristic, the specific name *lacrymans* (weeping) has been given to

the fungus. The actual damage in the present case was perhaps less than one hundred dollars,. but there was also the danger of possible future attacks, which might be even more serious, especially if the fungus worked into the main part of the church.

*Preventive measures.* At the suggestion of the writer, all of the infected woodwork was cut out, and even the plastering and laths were removed where the fungus showed. The lower boards on the sealed side of the furnace room were also taken off to allow a circulation of air between the partitions. All the infected material was destroyed, and the basement was also cleaned of all rubbish. The drainage was carried away from the walls of the church to keep these from becoming damp. On July 21st, after the diseased wood had been removed, the writer thoroughly sprayed the ground, plastering, and boards near where the fungus had been at work, using water containing two per cent. of formalin and two per cent. of carbolic acid. This was done in order to kill any scattered spores or superficial mycelial strands that might have escaped notice. That this spray was effective against exposed mycelia was shown by spraying part of a badly infected board. This was then sawed in two, and the sprayed and unsprayed pieces were placed for some time in a moist chamber. The sprayed half never made any growth of the fungus, except a slight development on the cut end of the board from the deeply imbedded fungus threads. On the unsprayed board, however, the fungus developed abundantly.

The partition has not yet been replaced, being left out to see if the fungus will develop any further. At this date (March 15th, 1907) it has showed no signs of reappearing.

## IV. ROOT ROT OF TOBACCO,

*Thielavia basicola* (B. & Br.) Zopf.

### GENERAL CONSIDERATION OF THE TROUBLE.

*Discovery of the trouble in Connecticut.* During the past season a serious root disease of tobacco has been prevalent in certain seed beds and fields in this state. While probably not an entirely new trouble, it certainly has not heretofore attracted any special attention among tobacco growers. Neither has the fungus [*Thielavia basicola* (B. & Br.) Zopf] causing it been previously reported on tobacco by the botanists of this station, though Thaxter in 1891 found it causing serious injury to violets. Mr. Shamel, of the United States Department of Agriculture, who is coöperating with this station in a study of the improvement of tobacco by selection and breeding, was the first to report it on this plant in the state. In an interview with Mr. Shamel printed in the Hartford *Daily Courant* of May 28, 1906, attention was called to the serious injury caused by the root rot in the tobacco beds of the Connecticut valley. It was also stated in this article, apparently from personal observations, that this disease had proved a very serious pest in Cuba, and had spread to an alarming extent all over the tobacco-growing districts of America. Mr. Shamel strongly recommended sprinkling the seedlings, in seed beds showing the trouble, with formalin. In view of this serious report, which was partially copied in a number of papers over the state, and because of its especial interest in the tobacco industry, this station, through its director and botanist, made a careful study of the diseased seed beds and the fields during the remainder of the season. There is given here a complete report of this investigation.*

*History elsewhere.* The fungus responsible for this trouble was first described from England by Berkeley and Broome in 1850. They reported it as a probable parasite on the base

* A preliminary report (6) of the investigation was made by the Director and the Botanist in Bulletin of Immediate Information, No. 4, of this Station.

of the stems of peas and another plant. Zopf, of Germany, in 1876, however, was the first to give a complete account of the different stages of the fungus. He found it injuring the roots of a species of Senecio, and some years later also on the roots of a number of leguminous plants. Thaxter was the first to report the fungus from America, having found it, as previously stated, on the roots of violets in this state. Peglion was apparently the first to find the fungus injuring tobacco. In 1897 he made a report of injury to the roots of tobacco in the fields of Italy. He thought that the water-clogged condition of the soil was in part responsible for the serious injury done by the fungus. Selby, of the Ohio Experiment Station, was the first to find the fungus on tobacco in the United States, having seen diseased specimens from seed beds as early as 1899.

*Nature of the fungus.* There seems to have been doubt in the minds of some of the investigators as to the exact parasitic nature of the fungus. In the first place it belongs in a family of fungi that consists chiefly of saprophytic forms, having a few weak parasites. The other two species that have been placed under the genus *Thielavia* are both saprophytes, one having been found on dung and the other on dead stems of Carduus. The fact that the fungus occurs on the roots also tends to obscure its true nature and apparently at times to induce a saprophytic existence.

Berkeley (2) said of the fungus: "It is either destructive of the plant on which it grows or is developed on it in consequence of previous disease." Zopf (24) considered it a true parasite producing characteristic injuries to the roots, which he called "Wurzelbräune." Sorauer (17) concluded that it led a saprophytic as well as a parasitic existence, as he found it developing on certain leafmolds, and he also stated that it might occur in the soil at times without doing injury to the roots of plants grown there. Peglion (9), as we have already stated, thought that unfavorable conditions for root development, a water-clogged condition of the soil, influenced its attack on the field tobacco in Italy. Selby (13) while noting that the fungus caused evident injury in the seed beds, stated that "the field development of the trouble remains open for study with us." Aderhold (1), who made some infection experiments, failed

to infect *Begonia semperflorens*, though his cultures originally were obtained from a diseased Begonia, but he did succeed with several other species. He was able in these cases, however, to produce the disease only at the crown of the plants. This seems peculiar since with tobacco it is the rootlets that were found most injured. It is quite probable, however, that if infection experiments were carried on with seedlings that the roots would be readily infected. Aderhold agrees with Sorauer that the fungus becomes an aggressive parasite only under certain favorable conditions. Shamel (15) evidently considered it a very injurious and aggressive parasite.

In Connecticut some of the growers were inclined to regard the fungus as only an incidental, or at least a secondary, factor in the root rot of the tobacco, especially of that in the fields. After an extended study of the subject the writer has no doubt of the parasitic nature of the fungus under certain conditions and believes that it was directly responsible for the serious injury in the seed beds this year. Whether or not the very conspicuous trouble in certain of the tobacco fields of Suffield was primarily and chiefly due to it is not so easily settled in our mind, though there is no doubt that it was at least partly responsible. In any case the development of the fungus and the consequent injury to its hosts depends largely on certain environmental conditions (nature of soil, moisture, etc.) which will be discussed later.

*Hosts and distribution.* In order to determine how common this fungus is and how large a number of plants it has for hosts, the writer made a rather careful examination of the literature of the subject and also sent inquiries to a number of men who would be most likely to know of its presence in the various tobacco districts in the United States, Cuba and Porto Rico. As a result of this search no one was found who had observed the fungus (based on microscopic examination) on tobacco plants in Cuba, Porto Rico, Kentucky, North Carolina, South Carolina, West Virginia, Pennsylvania, Tennessee, Florida, Texas or Wisconsin. This does not mean necessarily that the disease does not exist in any of those states but simply that no reliable information is yet at hand for stating positively that it does. So far, then, the fungus has been found on tobacco only in Italy, Ohio and Connecticut, but we have reason to

believe that it also occurs in Massachusetts and possibly in South Carolina. If it occurs in Cuba, the experiment station there, at least, is entirely ignorant of its presence.

All of the hosts and localities, with the authorities for the same, so far noted, are as follows: *Aralia quinquefolia,* Ginseng, Ohio (Selby); *Begonia rubra,* Ohio (Selby); *Begonia* sp., Germany (Aderhold); *Cochlearia Armoracia,* horseradish, Kazan, Russia (Sorokin); *Cyclamen* sp., Germany (Sorauer); *Lupinus albus,* Halle, Germany (Zopf); *Lupinus angustifolius,* Halle, Germany (Zopf); *Lupinus luteus,* Halle, Germany (Zopf); *Lupinus thermis,* Halle, Germany (Zopf); *Nemophila auriculata,* King's Cliffe, England (Berkeley & Broome); *Nicotiana Tabacum,* tobacco, Italy (Peglion, Cappelluti-Altomare), Ohio (Selby), Conn. (Shamel, Clinton); *Onobrychis Crista-galli,* Halle, Germany (Zopf); *Pisum sativum,* pea, King's Cliffe, England (Berkeley & Broome), Halle, Germany (Zopf), Gembloux, Belgium (Marchal); *Senecio elegans,* Berlin, Germany (Zopf); *Trigonella caerulea,* Halle, Germany (Zopf); *Viola odorata,* Conn. (Thaxter).

Besides the above host Aderhold, by means of artificial inoculations, infected *Scorzonera hispanica, Daucus Carota, Beta vulgaris* and *Apium graveolens* slightly and *Phaseolus vulgaris* more prominently. There is also some indication that the fungus attacks somewhat some of the weeds in the tobacco beds in Connecticut. These references show that the fungus has a wide range of hosts, which are widely scattered among the different families of flowering plants, but that, so far as reported, those of the leguminose family are most generally attacked.

*Structure of the fungus.* The mycelium or vegetative part of the fungus consists of hyaline, septate, branched threads that penetrate into the tissues of the root eventually causing their death. The mycelial threads are of rather narrow diameter, chiefly 3 or 4μ and their branches are usually formed near the apex of a cell, the branch being cut off by a septum at its base, as shown in Fig. 14, a. The mycelium developed externally on the hosts soon becomes slightly tinted and eventually gives rise to three kinds of spores, or reproductive bodies. Zopf (22) in his original article described a fourth kind of spores (stylospores or spermatia in pycnidia), but as

he did not mention these in his later article, and as others have not described them, it may be that he was mistaken about their being connected with this fungus. The writer, at least, has not seen them, but all of the other kinds were found on the diseased tobacco roots.

The first kind of spores formed are called endospores, Fig. 14, c, because they are formed inside a special thread of the *mycelium*. This special endospore case is formed terminally on

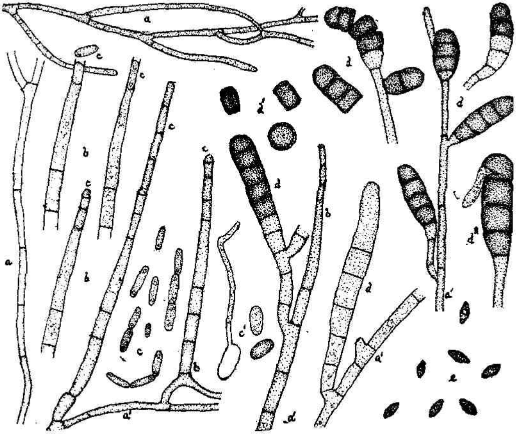


FIG. 14. *a*, mycelium ($a^1$, fertile); *b*, endosporous threads; *c*, endospores ($c^1$, germinating); *d*, chlamydospores ($d^1$, fragmenting, $d^2$, germinating); *e*, ascospores.

the thread or on terminal, somewhat clustered branches. It has a slightly swollen base, usually with several short basal cells, and a long tapering terminal cell. The endospores are gradually formed in the apex of this terminal cell in a basipetal manner and are pushed out of the ruptured end by the growth of the unfragmented protoplasm of the base. Usually these fertile threads are slightly tinted but have very thin walls, so that it is

often necessary to use the highest powers of the microscope to determine that the spores originate internally in the thread and not by its direct septation. Often one can see endospores slightly protruding beyond the case and in old specimens examples are found where the case projects beyond the terminal endospores as shown in Fig. 14. In nutrient cultures very often these endospores remain attached in long strings after being pushed out of the case. The endospores are hyalin, thin walled, oblong to linear, and vary in size from 10 to 25$\mu$ in length by 4 or 5$\mu$ in width. They have a conspicuous nuclear-like body in either end. Aderhold does not consider the endospores as sporangial spores but rather as conidia.

The second kind of spores formed are the chlamydospores, Fig. 14, d, which are thicker walled, dark reddish brown bodies. They rarely germinate soon after formation and so are in the nature of resting spores and are adapted for carrying the fungus over periods unfavorable for growth. They are borne on the same mycelium as the endospores, often as side branches at the base of an endospore thread. Some writers have considered them as simple spores adhering in chains, but they are more properly considered as compound spores consisting of one or two, rarely three, sterile basal cells and one to seven fertile cells. The basal cells are hyaline or slightly tinted, while the fertile cells are dark reddish brown, thicker walled and eventually separate into pill-box shaped individual cells. As a whole the compound spores are oblong with the terminal fertile cell rounded and sterile basal cells tapering slightly toward the base. The length of the spores, excluding the sterile base, varies from 20 to 50$\mu$ and their width from 10 to 15$\mu$. While these spores are usually formed on the mycelium externally on the root, they are sometimes produced sparingly inside the cells of the root. In this case they resemble the Torula fungus, hence Berkeley's classification.

The third kind of spores are the ascospores, Fig. 14, e. These are dark colored, single celled, lenticular spores about 12$\mu$ in length by 5$\mu$ in width. They are produced in asci, or hyaline sacs, each ascus containing eight ascospores and in turn these asci are enclosed in a special spherical receptacle called the perithecium. While we have found these ascospores common on the older tobacco roots, especially toward the end of the

season, they were always shed out on the tissues, which indicated that the asci and perithecia were either very fragile or temporary. So far as our own observations go we could not positively assert their relationship to the other spore forms of the root rot fungus, but from their presence and the observations of others there seems to be no reason for doubting this relationship. Though the fungus develops under ground it is well provided with means for its propagation and dispersal through these various spore forms.

*Artificial cultures.* Aderhold was apparently the first to make pure cultures of the fungus on various sterilized media. The writer has also obtained cultures from diseased tobacco roots. At first some difficulty was experienced in getting any growth of the fungus, either because the spores did not germinate or because this fungus was easily crowded out by bacteria and other fungi. Finally, however, several isolated colonies (possibly from endospores) appeared in a Petrie dish separation culture of acid potato agar in which spores from a freshly diseased tobacco root had been used. From these, pure cultures in test tubes were easily obtained. The fungus grows very readily on potato agar and soon produces an abundance of its endospores and later of the chlamydospores. It forms a slight aerial growth that at first is greyish but with the production of chlamydospores the cultures finally become quite dark colored. So far the ascosporous stage has not appeared in the cultures; but, as very often such stages do not appear in cultures, this is no real proof that it is not a stage of the fungus as declared by Zopf.

These artificial cultures give very favorable opportunity for studying the fungus in detail and for determining points in its life history not easily made out otherwise. For example, the writer has only occasionally seen the endosporous stage on the roots of tobacco and it might easily be entirely overlooked. In the cultures, however, this stage is the first to appear and produces the endospores in great abundance on the *surface* of the agar, while the chlamydospores are produced chiefly imbedded in the agar, to which it gives a blackish color in time. The endospores germinate readily in drop cultures of potato agar and manure-water but usually fail entirely to germinate in pure water. The fungus also grows readily on sterilized horse dung. These facts seem to indicate that the endospores

are aerial spores and would develope abundantly in manure piles, thus greatly facilitating the spread of the fungus. Several writers have spoken of finding a whitish growth (apparently an aerial growth of the endosporous stage) at the crown of infected plants, but so far on tobacco we have seen no such growth but have found chiefly the chlamydospores forming a blackish growth occasionally at the crown but chiefly on the roots or rootlets anywhere under ground. As the fungus is still under investigation further details of its structure and life history will not be given here.

*Synonomy and relationships.* As has been stated, Berkeley and Broome first described this fungus, placing it under the genus Torula because of the Torula-like character of the chlamydospores, which were the only fruiting stage observed by them. Zopf was the first to recognize the endosporous and the ascosporous stages and because of the latter he placed it in a new genus which he called Thielavia. This same year, 1876, Sorokin (18), of Russia, found the chlamydospores on the roots of horseradish and, thinking the fungus to be a new species, called it *Helminthosporium fragile.* Sorauer (16), in 1886, apparently, was the first to recognize Sorokin's species to be the same as Berkeley's, for this same year Saccardo (11) ignored their identity by placing Sorokin's species under a different genus, Clasterosporium. The correct name of the fungus and its synonomy, so far as now known, is as follows:

**THIELAVIA BASICOLA** (B. & Br.) Zopf. Sitz. Bot. Ver. Prov. Brandenb. **18**: 101-5. Je. 1876.

*Torula basicola* B. & Br. Ann. Mag. Nat. Hist., II, **5**: 461. 1850.

*Helminthosporium fragile* Sor. Hedw. **15**: 113. Au. 1876.

*Clasterosporium fragile* Sacc. Sacc. Syll. Fung **4**: 386. 1886.

Winter (21), Zopf (24) and Saccardo (10) all placed the genus Thielavia under the family Perisporieae of the Perisporiaceae (the latter also including the family Erysipheae, the powdery mildews); but Fisher (4) did not consider the genus at all related to the powdery mildews, as he placed it in the family Aspergillaceae of the Plectascineae. All the writers,

however, consider Thielavia nearly related to the genera Penicillium and Aspergillus, or the common blue molds. So far only two other species of Thielavia have been reported and in both of these only the ascosporous stage is described by Saccardo. Thielaviopsis is a possibly related genus, though no ascosporous stage is known, as one of its conidial stages is very similar to the endosporous stage of *Thielavia basicola*.

## DETAILED CONSIDERATION OF THE TROUBLE IN CONNECTICUT.

### *In the seed beds.*

*Difference between dampening off and root rot.* For years the tobacco seed beds of Connecticut have been injured more or less by dampening off fungi. These dampening off troubles however, are quite distinct from the root rot disease. With the former, the stems of the young plants are attacked above ground by certain fungi which, when soil and air are very moist, may develop on the surface of the beds and on the base of the plants as delicate, whitish, cobweb-like growths. These filaments of the fungus penetrate into the tissues of the stem and induce a soft rot of the tissues which causes the plants to collapse and a further rot of the leaves takes place, especially if in contact with the ground. Thus vacant spots appear in the beds where all the plants have been rotted out; or, when the trouble is not so bad the stand is thinned by the death of a few individuals. Frequently a plant may be attacked, but, through rapid growth or moisture conditions unfavorable for the development of the fungus, escape injury further than a cankered area on the stem. These dampening off troubles are augmented by very damp and cloudy spring weather, and not infrequently are started by lack of skill or care in watering or ventilating the beds. As the fungi are capable of living in the vegetable mold of the soil, they become established in the beds and cause more or less injury each year.

*Characteristics of root rot.* The root rot fungus, on the other hand, develops almost entirely underground, attacking the roots and underground part of the stem. The tap root, which is prominent in the young plants, is often rotted off close to the stem or there may be a general rotting of the tap and secondary roots, as shown in Plate XXIX. Not infrequently

severely injured plants form new secondary roots further up on the stem and under favorable conditions partly or entirely outgrow the trouble. Sometimes the roots are only slightly injured, having the secondary roots rotted off near their ends or there are scattered diseased spots that may be finally outgrown, as the fungus does not develop so readily on the larger and harder roots. All of this injury, except rarely a cankered spot on the base of the stem, is hidden from view until the plants are pulled up. When this is done one is often surprised to find how easily the plants separate from the soil, but an examination shows that there were few or no roots to hold the plants to it.

The grower usually first notices the trouble by the plants failing to make normal growth or coming entirely to a standstill. The leaves may show to his critical eye an unhealthy dark green color which he often describes as "black." In time there is a very uneven stand of the plants in the bed due to some plants being more injured than others. Eventually there may be a sickly yellowing of the older leaves. While some of the plants are killed when quite young and others may be carried off later, still it is very remarkable how many of the plants continue to live even when most of their roots have been rotted off. On a bright day this lack of root system becomes evident through the premature wilting of the plants. Later in the season the beds may show considerable improvement, since the plants have had time to develop new roots and the warmer, drier weather is more favorable for their outgrowing the disease.

*Extent of the trouble.* In order to determine how general the trouble was in the seed beds of the state, the writer, by visits, personal inquiry and correspondence, attempted to locate as many of the infested beds as possible. Such beds were seen at Simsbury, Granby, Tariffville, Poquonock, Hockanum and Portland. In all, however, the disease was definitely located in the beds of less than twenty growers. Often only one of the beds of the grower was seriously injured. No doubt this does not show the complete distribution of the trouble, as some growers are reticent about giving information concerning such diseases. Others may have suffered but slightly from the trouble and so it would easily escape their notice; still others

may have suffered in ignorance of its real nature, as some growers at first were inclined to lay the trouble to fertilizer burn. All of these infected beds were in the Connecticut valley, the chief tobacco region of the state. Although similar effort was made to find the trouble in the smaller tobacco region of the Housatonic valley, not a single case was found or even heard of in this region.

*Loss caused.* The disease at its worst practically ruined the beds, as few of the growers would risk planting from such beds. This meant the loss of time, etc., in taking care of the bed, often the purchase elsewhere of healthy plants and frequently a delay in setting out the fields. One grower estimated that this loss to him was equal to one hundred dollars. In other cases growers, who set from beds that did not show the trouble badly, became scared afterwards because the plants did not start promptly, and they plowed these up and reset with plants from uninfected beds.

*Experiments tried.* (1) Sprinkling seedlings. Mr. Shamel, in the article in the Hartford *Courant,* was reported as strongly recommending "that upon the first appearance of the pest the remaining plants in the beds must be sterilized with a solution of formaldehyde," of a strength of 1 to 2000 of water. He recommended sprinkling the affected beds once a week with the formalin, thoroughly soaking the plants and the soil. Mr. Shamel based this recommendation on some beds he had sprinkled with formalin where the treated plants afterward seemed to make a better growth than those not sprinkled. In view of this recommendation the writer had treated a part of a bed badly infected with the root rot at Portland. This bed was first treated June 11th with formalin of a strength about 1 to 1500. A very thorough sprinkling was given the plants, using at the rate of a gallon to each six square feet of the bed. Altogether the plants were sprinkled with the formalin five times, June 11th, 13th, 15th, 19th and 25th. The plants were finally examined July 10th by the writer, and the treated plants did not seem to be any better, more vigorous, or freer from root rot than those side by side that were not treated; neither had the owner noticed at any time any indication of a better growth in the treated part of the bed.

We also had the opportunity to examine several beds at Hockanum and Simsbury that were sprinkled two to several times under Mr. Shamel's direction, but in no case were we able to find any positive evidence that the sprinkling had been of value in checking the root rot or hastening a healthy growth of the diseased plants; and two out of the three growers who had tried the experiment reported unfavorably for the treatment. One of the growers, however, thought that the treatment had been of benefit to his beds, but in this case, so far as the writer could determine, this benefit, if any, was not in preventing the root rot, but rather in lessening dampening off of the plants, which is another disease altogether.

From the theoretical side this treatment does not seem to promise much, since the formalin must be used in very weak solution, so as not to injure the foliage or roots when sprinkled on the plants. It is quite possible that this weak formalin might act unfavorably on the very thin-walled endospores of the fungus, but on the thick-walled chlamydospores, which are the common spores on the roots, it is doubtful if such a weak solution would have as injurious an action as it would on the tender root hairs of the tobacco. Then, too, the mycelium of the fungus on the diseased roots is largely within their tissues, and certainly this would not be killed without killing the roots themselves.

Taking all the evidence into consideration, we do not believe that sprinkling beds already showing the disease will be of value in lessening injury from root rot, and we doubt if such treatment will be of any considerable value even if it is begun before the appearance of the rot. Now, in this statement, we do not include the dampening off and stem rot troubles, since in some of the beds having these troubles there did seem to be some benefit derived from the treatment. In these cases, however, the sterile threads of the fungus creep exposed over the surface of the ground and on the plants, and considerable moisture is necessary for their development. If, then, in place of the ordinary water, the weak formalin is used, while it might not kill the fungus threads, it certainly would not be so favorable for their further development. This phase of the subject is discussed under the Stem Rot of Tobacco, page 327 of this report.

(2) Sterilizing the soil. While the sprinkling method does not appear to the writer to have much value, the use of stronger formalin on the soil, as a disinfectant, before the beds are seeded down did seem to be of value in killing out the root rot fungus. and so exempting the seedlings from its attack. Selby of Ohio has already obtained encouraging results against other soil fungi by such treatment. To test this in a preliminary way, soil from an infected bed was obtained and placed in boxes in the greenhouse. On June 23d, the soil of box 1 was thoroughly soaked with formalin of a strength of 1 to 100 of water; the second, with formalin of a strength of 1 to 200, and the third, or check, merely soaked with a similar amount of water. After covering for a day to keep in the fumes, the soil was stirred and aired for a week to allow the formalin to escape. The boxes were then seeded with tobacco, and afterward treated alike throughout the test. Root rot did not develop as badly in any of these boxes as it had earlier in the seed bed from which the soil was taken. It did appear in time somewhat prominently in the untreated box. There was also some in the box treated with the weaker strength (1 to 200) of formalin, thus indicating that this treatment was not quite strong enough for practical use. In the box treated 1 to 100, while there was a very slight trace of the rot, the treatment practically prevented it. In neither of the treated boxes did the formalin seem to retard germination, or injure the plants afterwards, but instead, these boxes really gave a thicker stand of plants.

From the preceding experiment it seemed probable that thorough treatment of an infected bed with formalin of the strength of 1 to 100 might prove very useful in preventing the root rot. Consequently part of a badly infected bed at Portland was treated on July 10th. A thorough soaking was given, using a gallon to every 1½ square feet. The treated part was covered with sash for a couple of days to hold in the fumes, and then aired for about a week before seeding it and the adjacent untreated strip, which was to constitute the check. The illustration, Plate XXX, a, shows the condition of the treated and untreated plots of this bed on September 5th. As is seen from this, plants in the treated part were much larger, being large enough for setting out, and there was a thicker and more uniform stand. There was no indication of

disease to the naked eye. A microscopic examination of the roots showed only traces of the root rot fungus. The untreated plants, on the other hand, revealed some external signs of the trouble, by the dwarfed, darker colored foliage, and an examination of the roots showed the fungus present on all of the plants, in some cases rotting the roots badly. A later examination, on September 24th, still showed the plants in the treated soil superior to those in the untreated; and the owner stated that the difference in weeding the beds had been greatly in favor of the treated part, which indicated that the treatment had been strong enough to kill many of the weed seeds. The only thing that prevents the conclusion that this evident difference between the treated and untreated plants was entirely due to the treatment is the fact that the untreated part of the bed was not soaked down at the time of treatment with an equal amount of water. It is barely possible that the thorough soaking the treated part received was in itself a favorable condition for better plants during the month of July. This month, however, was rather moist, and after seeding the treated and untreated parts were watered alike, apparently as often as needed. Any great amount of water in the soil in the untreated part would have been more favorable for the development of the root rot. Because of this drier condition of the soil, and possibly because of other seasonal conditions, as heat, the root rot was not so bad in this bed as in the spring. Even the dwarfed plants had a better root system, as shown by their not being so easily pulled from the soil. There was no question, however, that the treatment was at least partially responsible for the difference in the condition of the plants.

Based on the above experiment, parts of two other seed beds were treated in the fall to determine the efficiency of this treatment. Another was treated this spring to determine the comparative value of spring and fall treatment. In the fall treatments a very thorough soaking with formalin, 1 to 100, using one gallon to each square foot, was given. It is quite possible that this thorough soaking of the ground in spring, when the soil is naturally moist, will not always allow it to dry out sufficiently for the most favorable growth of the plants, so only ⅔ of a gallon per square foot was used. The results of these experiments cannot be reported until later.

Besides the sterilization of the soil with formalin, part of a bed in one of the fall treatments was sterilized with steam by means of a steam rake, whose teeth were forced into the soil. Of course the comparative merits of this treatment and the formalin treatment are not yet determined, but in so far as cost and quickness of treatment are concerned, the formalin method without question is far superior. As the result of our various experiments and observations, later in this article, under Preventive Measures, we recommend certain tentative treatments for the prevention of the root rot.

### *In the fields.*

*Effect on the plants.* Beside the backset early in the season, which many plants entirely or largely outgrew, there were other cases where the plants made no satisfactory growth the whole season. Examination of the roots showed that the fungus had continued its injurious action here during the season. Such plants usually did not have the normal main and fibrous root system shown in the healthy plant in Plate XXXI, b; but the main roots were more or less rotted off or easily broken when pulled up from the ground, and the development of the fibrous roots and rootlets was very deficient (Plate XXXI, b) or abnormally clustered at the crown. The fungus evidently can work on the young rootlets and the small fibrous roots much easier than on the larger and more woody secondary roots. While it sometimes rotted off the larger roots, it more frequently showed as an encircling banded blackish growth that was apparently doing comparatively little injury. These blackish growths (Plate XXXI, a), in the examination of the washed roots, gave a very good idea of the abundance of the fungus and its probable injury to the plant. So far as was learned, the fungus did not attack any part of the plant above ground, though occasionally plants with black sunken areas were found where the trouble may have had its start from a root rot injury.

*Extent of the trouble.* In order to determine how general the fungus was in the fields, the writer made a careful examination of forty-six different fields scattered over the state. These were examined chiefly after the tobacco had been cut in the fall. The roots of at least ten plants in different parts of

each field were pulled up and washed and then examined for the characteristic black spots of the fungus. These tests were verified later by a microscopic examination. Twenty-eight of these fields were in seven different towns in the tobacco region of the Connecticut valley. In all of these fields, except two, the fungus was present, at least to some extent on the roots, thus showing it to be quite general in its distribution in this valley. In two towns in the Housatonic valley eighteen fields were examined, but the fungus was found only in eight of these.

*Damage done.* In none of the fields in the Housatonic valley was the fungus found in any abundance, and in most of the eight cases only a trace of it was seen on a few of the roots. Neither was there complaint by the growers of any trouble that could at all be attributed to this fungus. So it can be pretty safely stated that in this valley there was no injury this season from the root rot. In at least eleven of the twenty-eight fields in the Connecticut valley the fungus was found abundant enough on the plants examined to have caused appreciable injury. In all of these cases conversation with the owners showed that the field as a whole or in spots had not done as well as it should have done. In some cases it was merely a small spot or portion of the field that did not give a normal growth, and an examination of the roots from these places always showed more serious injury by the fungus than in the rest of the field. Serious damage to the fields as a whole, however, was confined chiefly to the region of Suffield, and here the root rot was most abundant. In this town a number of the fields of some of the best tobacco growers did unusually poorly in a year when the crop in general was unusually good. In these fields the tobacco at harvest time was smaller than it should have been and on certain areas made no satisfactory growth through the season and so was practically worthless. The tobacco from these poorest spots often failed to cure down properly in the barns, some leaves still remaining green late in October, when the main bulk of the crop in the same barn was ready to come down. As some of the most seriously injured fields were of considerable size, this short crop meant a serious loss to the growers. According to one

grower, at least, the quality of this tobacco was not seriously affected.

*Secondary factors possibly determining the injury in the fields.* Some of the growers, especially with the seed bed trouble, were inclined at first to look upon the injury as a fertilizer burn. There seems to be little ground for this belief as regards the seed beds. Whether or not the presence of more or less of certain of the fertilizers used would stimulate or retard the growth of the fungus is another question not so easily answered. It is not definitely known whether an acid, alkaline or a neutral soil is best adapted to the growth of the fungus, which we know can grow in the soil itself apart from the tobacco root, but it is reasonable to suppose that this factor may have its influence. Neither can we state positively whether or not certain methods of field fertilization (showing in an excess or lack of certain fertilizer constituents this season) had an injurious action on the development of the tobacco aside from, and possibly in the worst fields greater than, the injury that was evidently caused by the root rot fungus. One of the growers whose fields suffered severely was inclined to lay it to the excessive use year after year of potash fertilizers, which gradually accumulated in the soil, and especially to the use of the carbonate of potash. Possibly the use of infected manure may have had a bearing, as this would be favorable for the development of the fungus. No special evidence, however, was obtained along this last line unless it was in the case of one of the seed beds.

A very prominent factor, undoubtedly, is moisture. One grower stated that the worst infected fields in Suffield were those that had been under tents a couple of years previously. If this was generally true, it is possible that the more moist condition of the soil when under the tents gave the fungus a better chance to develop and infect those fields later. A very moist soil seems to be most favorable for the development of the fungus, as the lower or damper spots in the fields usually showed the most trouble. The nature of the subsoil as regards drainage also may have had its bearing, especially early in the summer. The character of the past season no doubt was also an important factor. The cold wet weather of early spring helped along the trouble in the seed beds, particularly when

they were not properly ventilated. The rainfall* in June and July was considerably above the average, which was no doubt favorable for the growth of the fungus in the fields and may have had its bearing on the fertilizer question.

*Future injury?* The questions arise, is this trouble likely to occur as seriously in the worst fields another year, and will it grow more injurious in time in the fields where it is at present doing little or no damage? It is not possible to answer these questions definitely, because of the other factors than the mere presence of the fungus in the field that have an influence in determining the injury done. Taking all of these factors into consideration, and the fact that the trouble appeared so suddenly and prominently this year when no doubt the fungus must have been present in the soil, at least inconspicuously, for some time (as it now is in some parts of the Housatonic valley, with no injury to the crop), the writer is inclined to believe that it is not certain that the trouble will appear next year and thereafter with increasing severity. It seems most probable, aside from a certain slight injury each year, that the character of the season will largely determine whether or not serious injury, like that of the present year, takes place. However, it is very desirable for the growers to be well informed regarding the nature of the trouble and to do what is feasible in the way of preventive measures.

*Experiments tried in the field.* A number of observations were made and a few experiments tried to determine the exact nature of the trouble after plants had been set out in the field, for it was very soon determined that the fungus was present in the tobacco fields even in some cases where the growers had not noticed it in their beds. In these experiments and observations it was aimed to determine three things, namely; (1) Effect of transplanting diseased plants in the fields, (2) Effect of transplanting healthy plants into infected soil, (3) Effect of environment on the development of the disease. We will discuss these points briefly in the following paragraphs.

(1) Effect of transplanting diseased plants in the field. Naturally a grower, when he has a diseased bed, uses only the

* The rainfall at New Haven for June was over 5 inches, giving an excess of considerably over 2 inches when compared with the average for thirty-four years. The excess for July was .68 of an inch.

best plants from that bed, if he uses them at all. Some growers used plants from diseased beds, and seeing that they did not start promptly, plowed them up. In one case at Portland, a grower used at first the best plants from his diseased bed, and then becoming scared, bought the remainder of his plants. Those used from his own bed in the end made a more satisfactory crop than those he bought, because calico developed badly in the latter. He thought, however, that the plants from the diseased bed did not do quite as well as plants ordinarily did on the land in which they were planted. Another grower at Bushy Hill used plants from his diseased bed, but soon afterward plowed them all up except one row, and reset with plants from a healthy bed. At first the plants in the row that was left did not seem as thrifty as the healthy plants reset later, but at the end of the season they did not appear from a casual examination to be much different, except that they had more calico. In this same field one of the United States Government experts had also set out a row each from healthy and diseased beds. When, through the courtesy of the grower, the writer examined these two rows at the end of the season, the difference between them, if any, was not marked. Likewise some plants from diseased beds set out at Tariffville for the same purpose did not, to the writer, show any marked injury.

The only experiment tried by the writer was on the Experiment Station grounds, with a few plants obtained from diseased beds at Simsbury and Poquonock. These plants were set out in three rows. In the first row the plants were entirely too small for planting, and the roots were very badly injured. Such plants were used because they were the worst that could be obtained. In the second row the plants were in fair shape and almost large enough for planting, but the roots were rotted considerably. In the third row the plants were of fair size and appearance, showing very little rot on the roots, and were such plants as a grower would select as the best from the diseased beds. The plants were set in soil free from the fungus, and on a cloudy day, and were watered at first; but they did not have any special fertilization or cultivation. Unfortunately, soon after they were set out, a heavy rain badly washed the soil over some of the smallest plants in the first row, drowning out a few, so that this may possibly have had some influence on

their later growth. At the end of the season this test showed the following facts: (a) That very few plants had been killed outright by the root rot. (b) That at first those with badly diseased roots were considerably retarded in growth, since they had to form new roots. (c) That some of the badly diseased plants in the first row made only a very stunted growth during the whole season. Everything considered, those in the second row made a very fair growth, despite the fact that they started with considerable rot on the roots. Those of the third row made the best growth, and were fair plants. (d) The final examination of the roots on October 1st showed that there was then very little evidence of rot on them, even on the most stunted plants, so that evidently the fungus had soon been outgrown; what damage it had caused was that done to the young plants, from which injury apparently in the worst cases they had never recovered. There was no calico on any of the plants. Plate XXXII, b, shows a photograph of a part of these plants taken on October 1st, those in the foreground being in the first row.

From these observations and experiments we may reasonably conclude that because rot appears in a bed it does not necessarily mean that good plants taken from it will produce a poor, or even an inferior, crop. That badly diseased plants will do poorly, especially at first, there seems to be little doubt. That good plants showing some disease, under some conditions will do worse than under others, also seems certain. While we do not advocate the use of plants from diseased beds if others can be obtained, we do think that it is possible under certain conditions of soil, moisture, etc., for the best plants from these beds to do as well as plants taken from a bed not showing the disease. However, the grower in this case *must take a risk* that they will do as well.

(2) Effect of transplanting perfectly healthy plants in infected soil. As the disease showed in some fields when the plants were obtained from beds supposed to be free from the trouble, there is question whether they became infected in the field. If this were true, the fungus would evidently carry over in these fields from season to season, doing more or less damage as conditions were favorable or unfavorable, since tobacco is grown on the same land year after year. We believe that

said to be quite helpful in this respect, and it will probably also kill the soil fungi, near the surface of the ground at least. Too hot a fire, however, may burn out the humus of the soil or make plant food less soluble and so do as much harm as good. 2d, Sterilization by steam has been profitably employed against soil fungi and nematodes in greenhouses and hot beds for some time, and is now used in a few cases in this state to kill the weeds in tobacco beds. There is no reason why it should not be as successful in killing the root rot fungus as the other soil fungi. There is on the market a steam rake whose points when forced into a bed carry the steam into the soil from any attached steam boiler. The chief objection to this method of sterilization is the cost of the apparatus and the trouble and time taken in heating the beds. 3d, Treating the soil with formalin is another method that is coming into use for combating soil fungi. Preliminary tests with this method, as we have already stated, were made the past summer against the root rot fungus in the greenhouse and also in part of one of the badly infected beds, see Plate XXX, a. The results from these tests were so encouraging that we give the following tentative directions for its use:

It is perhaps better to treat the beds in the fall so that they may have a chance to dry out after the thorough soaking they receive. If treated in the spring they should be aired for a week before planting in order to allow the fumes of the formalin to escape and the soil to dry out as much as it will. Whether in fall or spring, the bed should be treated after the tillage is mostly done, for, if cultivated deeply after the treatment, untreated soil containing the fungus may be brought up from below. Commercial fertilizers may be used either before or after the bed is treated, but manure, if used, should be put on before so that it may be sterilized. Use only the strongest formalin, guaranteed 40 per cent. This can be bought in carboys holding about 100 pounds for 10 cents per pound, or a better article in pint bottles at about 40 cents. It is not necessary, however, to get the chemically pure article, but it is necessary to keep the bottles tightly stoppered to avoid loss of strength through evaporation. One pint of this formalin should be added to each twelve and a half gallons of water used or at the rate of one to one hundred by volume. This

should be applied immediately to the bed with a sprinkling can so as to evenly and thoroughly wet the soil, using two-thirds to one gallon to each square foot of surface. It may take some time for the soil to soak in the latter quantity, but if applied in partial amount it will soak in while the rest of the bed is being treated. The ground should be covered with the sash or canvas for a couple of days after treatment to help keep in the fumes.

*Sprinkling seedlings with formalin.* According to our observations and experiments, a very weak strength of formalin (about 1 to 1500) sprinkled several times on the plants in the infected beds did not give very favorable results. So far as the root rot is concerned we do not believe this treatment has much value after the appearance of the disease. As regards the dampening off troubles there was some evidence that this method may have benefited the beds slightly. Possibly if this treatment entirely supplanted the watering throughout the whole season of the beds, it would prove more serviceable, especially against the dampening off fungi.

*Treatment of the fields.* It is more difficult to advise as to the best treatment of the fields. Of course it is not desirable to use plants from infected beds, if others are available. Care in this respect, as stated before, does not necessarily mean that the trouble will be escaped in the fields. One grower has suggested that it might be well to use formalin in the water (1 to 1200) when the plants are set out. While it is not likely that this would prove of any great service, it might be worth trial on a small scale, to determine its value. Some form of rotation may be found necessary if the fungus persists in injuring each succeeding crop. One field was seen the past summer, part of which had been in corn the two previous years, and this part, according to the owner, did better than the remainder of the field; an examination of the roots also showed less of the rot there. Where one has reason to suspect that his soil is acid, it might be well to lime part of the field to see if this will prove helpful to the crop. On the other hand, if a grower has been using large amounts of potash (and the growers who used the most were among those whose fields suffered most) it might be well to cut down the amount used on part of his field and carefully compare this part with the remainder of the field

during the season in order to get data for determining the character of his fertilization another year.

*Examination of specimens.* During the coming season any grower who suspects he has this trouble in his seed beds or fields is at liberty to send specimens of the plants or the roots to the Experiment Station, at New Haven, for examination. In cases of severe injury or especial interest, inspection of the seed beds or the fields will be made if desired.

LITERATURE.

The following include all of the references in literature, of any importance, that the writer has found relating to this fungus.

1. **Aderhold, R.** Impfversuche mit *Thielavia basicola* Zopf. Arb. Biol. Abt. Land. Fortw. Kaiserl. Gesundh. **4**: 463–5. 1905. [Review: Centr. Bakt. Par. Infekt. **15**: 276–7. 1905.]
   Made artificial cultures and inoculation experiments; did not find it a very aggressive parasite in the trials made.
2. **Berkeley, M. J. and Broome, C. E.** Notices of British Fungi. Ann. Mag. Nat. Hist. II, **5**: 461. 1850. *pl. 11, f. 4.*
   Describes *Torula basicola* B. & Br. as a new species on base of stems of peas and *Nemophila auriculata* from King's Cliffe, England.
3. **Cappelluti-Altomare, G.** I semenzai del Tabacco e la *Thielavia basicola* Zopf. R. Inst. Scafati **1902**: 137–47. [Listed: Just Bot. Zahrb. *30: 858. 1902.*]
   Have not seen this reference.
4. **Fischer, E.** Thielavia Zopf. Engl. & Prantl Nat. Pflanzenf. **1**[1]: 299. 1897.
   Describes the genus and gives notes on the single species; places genus under family Aspergillaceae of the Plectascineae.
5. **Frank, A. B.** *Thielavia basicola* Zopf. Krankh. Pflanz. **2**: 278 1896.
   Gives a short general account of the fungus as taken from Zopf.
6. **Jenkins, E. H. and Clinton, G. P.** Root-Rot of Tobacco. Bull. Imm. Inform. Conn. Agr. Exp. Stat. 4: 1–11. N. 1906. [Illustr.]
   Give a general account of this disease in Connecticut.
7. **Marchal, E.** In Belgien im Jahre 1901 beobachtete pilzparasitäre Krankheiten. Zeitschr. Pflanz. Krankh. **12**: 48. *1902. Ibid,* **12**: 239. 1902.
   Reports *Thielavia basicola* killing roots of peas grown in water cultures.
8. **Orton, W. A.** Plant Diseases. Yearbook U. S. Dept. Agr. **1901**: 672. *1902. Ibid.,* **1903**: 554. 1904.
   Reports *Thielavia basicola* injurious in tobacco seed beds in 1901 and in 1903 in Ohio seed beds.

9. **Peglion, V.** Marciume radicale delle piantine di Tabacco, causato dalla *Thielavia basicola* Zopf. Atti Reale Accad. Lincei V, **6**: 52–6. 1897. [Reprint: Centrb. Bak. $3^2$: 580–3. 1897.]
Gives literature, botanical description of fungus, and records injury in tobacco fields of Italy, where water-clogged condition of soil favored the development of the fungus.

10. **Saccardo, P. A.** *Thielavia basicola* Zopf. Sacc. Syll. Fung. **1**: 39. 1882. *Torula basicola. Ibid.*, **4**: 257. 1886.
Describes these as distinct species but notes under former that the latter is a conidial stage of it.

11. **Saccardo, P. A.** *Clasterosporium fragile* (Sorok.) Sacc. Sacc. Syll. Fung. **4**: 386. 1886.
Places Sorokin's *Helminthosporium fragile* under *Clasterosporium.*

12. **Selby, A. D.** Diseases caused by Nematodes. Bull. Ohio Agr. Exp. Stat. 73: 228. 1897.
Found *Thielavia basicola* on roots of greenhouse begonias along with nematodes.

13. **Selby, A. D.** Root Rot (Black Root). Bull. Ohio Agr. Exp. Stat. 156: 95–7. 1904. [Illustr.]
Gives a short account of fungus and reports it in Ohio injuring tobacco seedlings.

14. **Selby, A. D.** Soil Treatment of Tobacco Plant Beds. Circ. Ohio Agr. Exp. Stat. 59: 1–3. O. 1906.
Gives suggestions for treatment of root rot based on experiments used with success against the Rhizoctonia fungus.

15. **Shamel, A. D.** Another Blight strikes tobacco. Hartford Daily Courant. 28 My. 1906.
Reports *Thielavia basicola* as causing serious injury to seedbeds of tobacco in the Connecticut valley; recommends sprinkling diseased plants with weak formalin.

16. **Sorauer, P.** *Thielavia basicola* Zopf. Handb. Pflanzenk. **2**: 333. 1886.
Gives short note on fungus and gives *Helminthosporium fragile* Sor. as a synonym.

17. **Sorauer, P.** Ueber die Wurzelbräune der Cyclamen. Zeitschr. Pflanz. Krankh. **5**: 18–20. 1895.
Gives account of injury to roots of Cyclamen by *Thielavia basicola.*

18. **Sorokin, N.** Ueber *Helminthosporium fragile* sp. n. Hedw. **15**: 113. Au. 1876. [Illustr.]
Describes the chlamydospores found on horseradish roots in Kazan Bot. Garden as a new species.

19. **Thaxter, R.** Fungus in Violet Roots. Ann. Rep. Conn. Agr. Exp. Stat. **1891**: 166–7. 1892.
Reports this on violet roots in Connecticut, being first report of the fungus in America.

20. **Tubeuf and Smith.** *Thielavia basicola* Zopf. Diseases of Plants: *182–3. 1897.*
Give a short general account of the fungus.

21. **Winter, G.** *Thielavia.* Rab. Krypt. Fl. $1^2$: *53. 1887.* [Illustr.]
Gives scientific description of genus and the single species *T. basicola,* with short general account of injury by latter.

22. **Zopf, W.** *Thielavia* Zopf. Genus novum Perisporiacearum. Sitz. Bot. Ver. Prov. Brandenb. **18**: 101–5. 1876. [Reprint: Hedw. **16**: 114-7. 1877.]
Describes this genus as new, placing *Torula basicola* B. & Br. under it as its only species; describes four spore forms.

23. **Zopf, W.** *Thielavia basicola* Zopf. Die Pilze: 91. 1890.
Have not seen this reference.

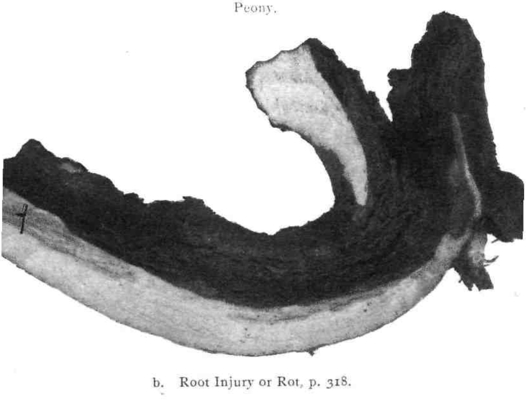
24. **Zopf, W.** Ueber die Wurzelbräune der Lupinen eine neue Pilzkrankheit. Zeitschr. Pflanz. Krankh. **1**: 72–6. 1891. [Illustr.]
Gives extended account of this fungus previously described by him and a list of plants which he found it injuring.

PLATE XVII.

Apple.

a. Combined Winter and Canker Injury, p. 310.

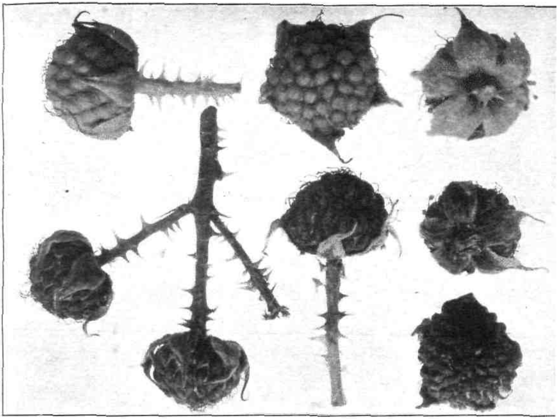
Peony.



b. Root Injury or Rot, p. 318.

DISEASES OF APPLE AND PEONY.

Raspberry. ×2.



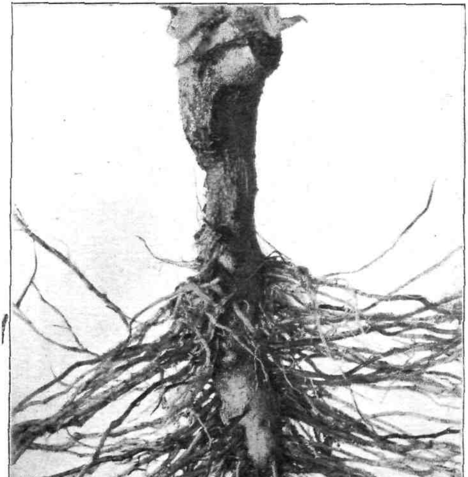
a. Wilt of fruit, showing upper healthy and lower diseased, p. 321.

Tomato.

b. Black Mold, p. 329.

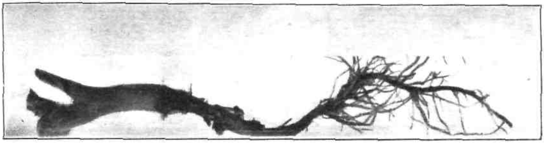
FUNGI OF RASPBERRY AND TOMATO.

a. Cankered area extending on stem from ground upward.



b. Stem girdled under ground.

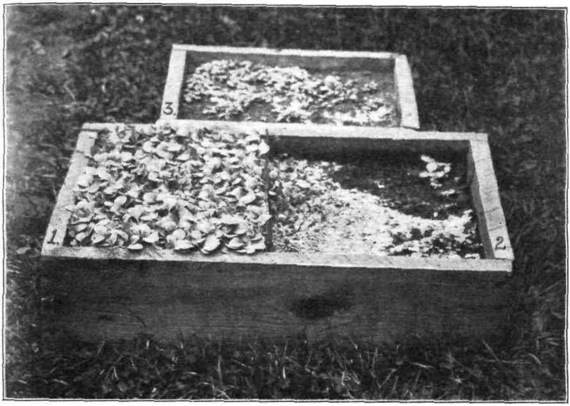
CANKER DISEASE OF TOBACCO, p. 325.



a. Showing rot of stem just above ground.

b. Showing cankered spots on older plants.

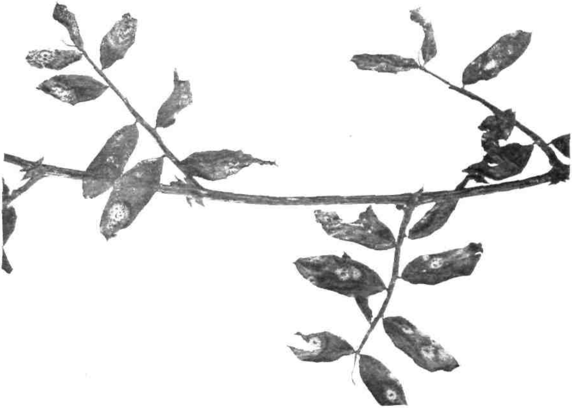
STEM ROT, *Sclerotinia* sp., OF TOBACCO, p. 326.




a. Effect of treatment in preventing Stem Rot fungus, p. 328.

b. Dampening off fungus at work among young plants, p. 326.

FUNGI OF TOBACCO SEEDLINGS.

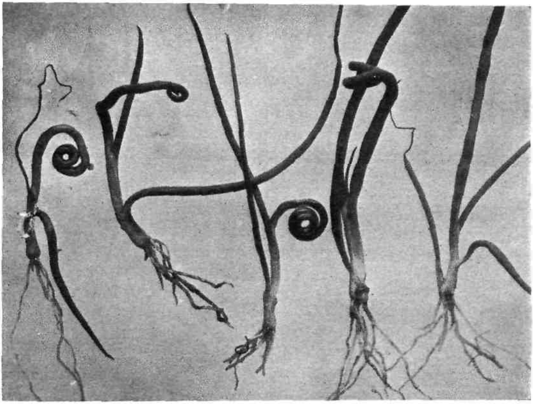


a. Leaf Spot of Russian Vetch, p. 330.

b. Speck Anthracnose of Violet, p. 331.

FUNGI OF RUSSIAN VETCH AND VIOLET, ×2.

a. Effect of disease on size of seedlings, p. 334.



b. Showing peculiar malformations of leaves, p. 332.

ONION BRITTLE.

a. Showing how disease spread across end of field, p. 333.

Untreated. + Treated.

b. Showing effect of treatment, p. 335.

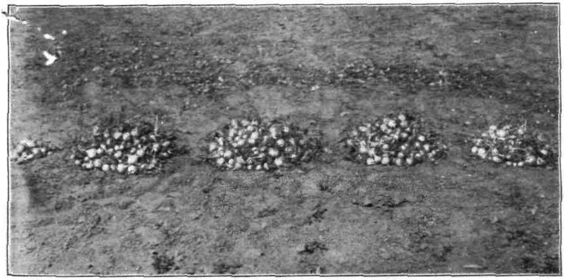
ONION BRITTLE.

a. *Untreated rows that failed to respond to extra fertilization,* p. 335.

Plots · 4 3 2

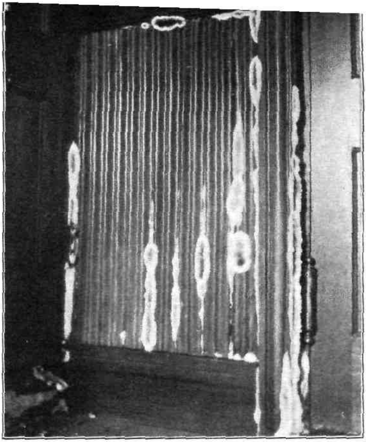
b. Adjacent treated rows photographed at same time and size as *a*, p. 335.

5 4 3 2 1

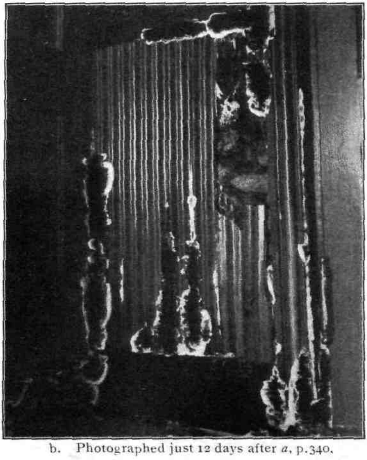


c. Results of treatment on yields from adjacent rows, p. 335.

ONION BRITTLE, *showing untreated and treated rows in detail.*

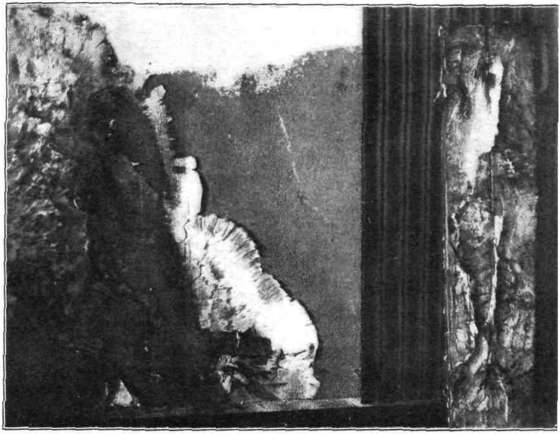


a. After having been scraped off, this new growth was made in less than two weeks.

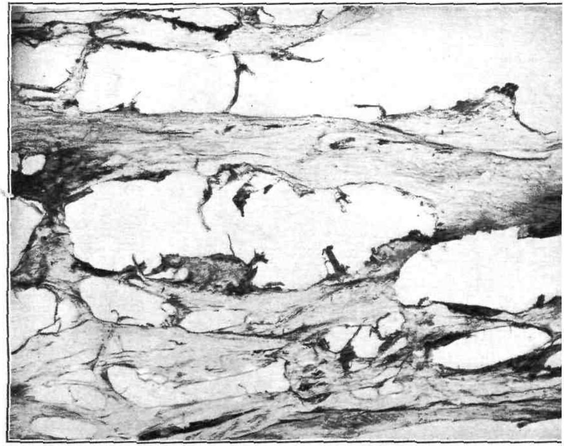


b. Photographed just 12 days after *a*, p.340.

DRY ROT FUNGUS, *Merulius lacrymans*.

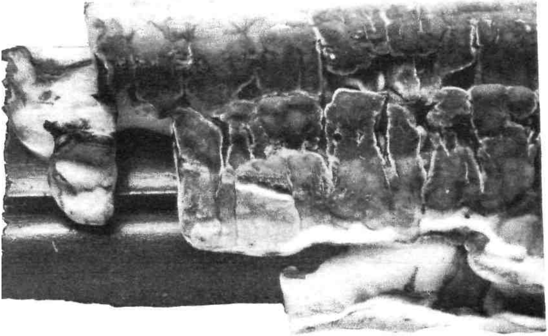


a. Showing growth made on plastering back of the wainscoting, p. 339.

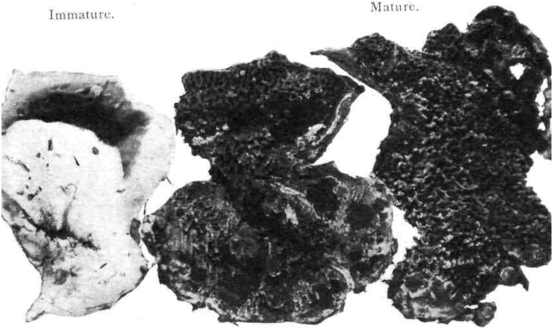


b. Sterile mycelial strands formed on back of the boards, p. 339.

DRY ROT FUNGUS, *Merulius lacrymans.*

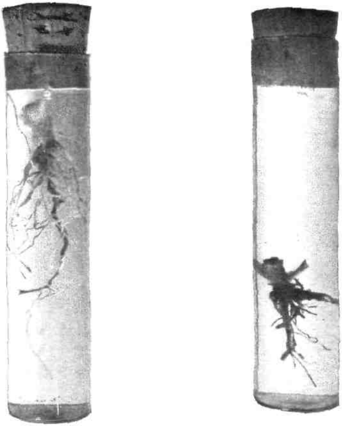


a. Immature fruiting stage, developing on front of board, p. 340.

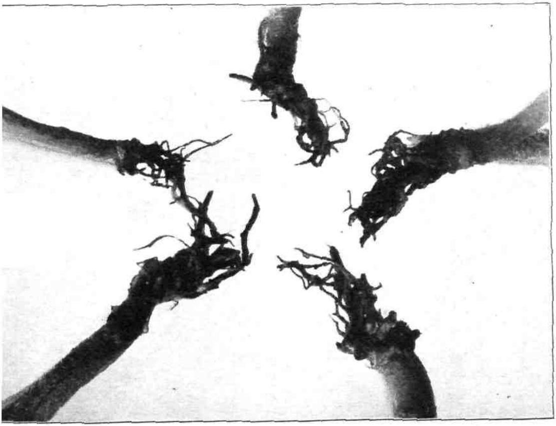



b. Fruiting or spore stage of the fungus, p. 340.

DRY ROT FUNGUS, *Merulius lacrymans.*



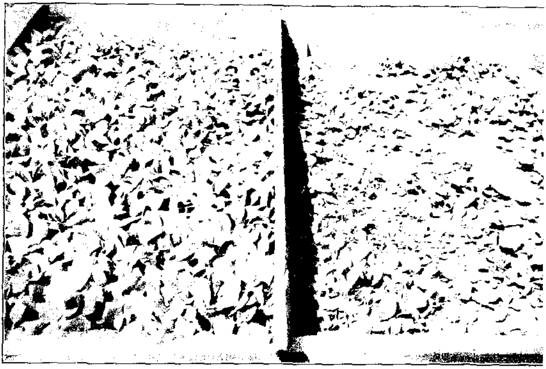

a. Comparative size of healthy and diseased roots of seedlings, p. 350.



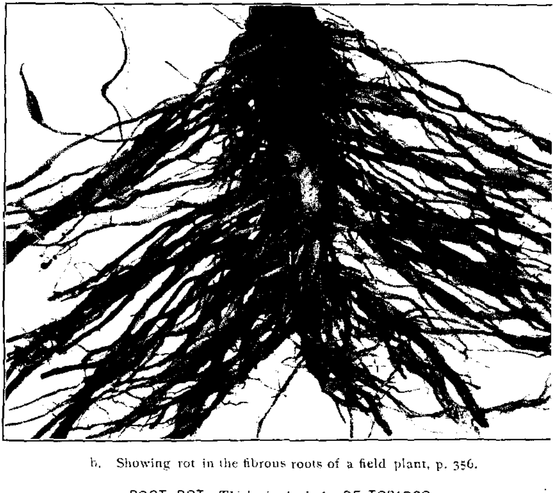
b. Showing badly rotted roots of seedlings. × 2.

ROOT ROT, *Thielavia basicola*, OF TOBACCO.

Treated. Untreated.



a. Apparent effect of soil treatment with formalin, p. 354.



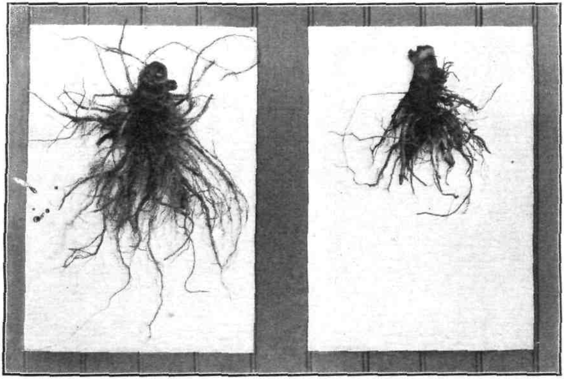
b. Showing rot in the fibrous roots of a field plant, p. 356.

ROOT ROT, *Thielavia basicola*, OF TOBACCO.

Healthy. Diseased.

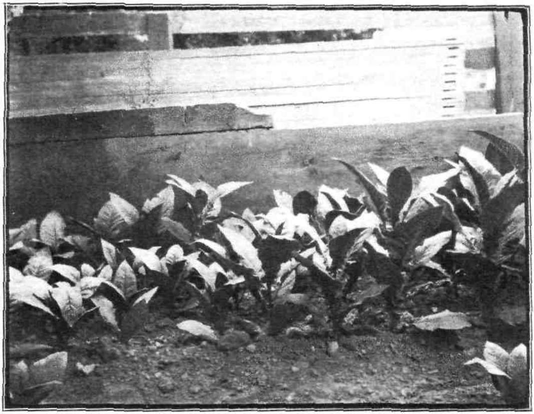
a. Appearance of the fungus on the large roots of field plants, p. 356.

Healthy. Diseased.

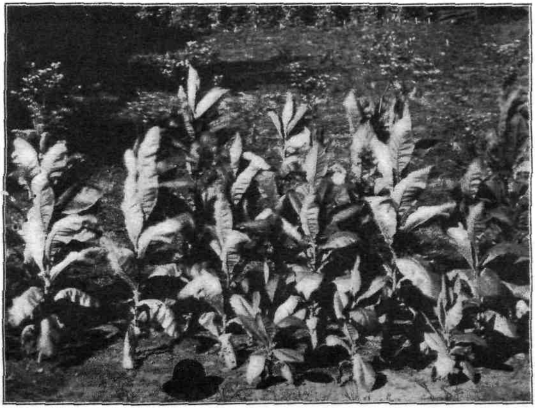


b. Effect of rot on roots of mature field plants, p. 356.

ROOT ROT, *Thielavia basicola*, OF TOBACCO.



a. Healthy plants that became diseased on transplanting in a diseased bed, p. 362.



b. Diseased plants transplanted in disease-free soil, p. 361.

ROOT ROT, *Thielavia basicola*, OF TOBACCO.

# PART VI.

## REPORT OF FORESTER AND CONCLUSION.

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## ANNUAL REPORT

OF THE

# STATE FORESTER OF CONNECTICUT

AUSTIN F. HAWES, M.F.

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### THE FARMER'S INTEREST IN WOODLANDS.

It is a well-known fact that less than one-half the area of Connecticut is utilized for the production of food stuffs. Since this non-agricultural half of the state, an area of nearly one million and a half acres, is largely in the hands of farmers, the great value to the farmers of any work the Experiment Station does for the development of their resources must be readily apparent. Statistics gathered from the New York, New Haven and Hartford Railroad Company indicate that about 1,500,000 ties, or one tie per acre per annum, are cut in the state. Since it should be perfectly easy to grow five ties on an acre, it should not require over 300,000 acres, and under good management considerably less, to produce the required number of ties; i. e., an area of this size should produce an annual crop to the owners worth, at present prices, about three-quarters of a million dollars. The cordwood and other products produced at the same time would make the value a round million. Statistics recently published by the United States Forest Service show that New England cut last year 600,493,000 feet of box boards, but that Connecticut only furnished two per cent. of this cut, or only about 12,000,000 feet. Fair pine land, when left to grow to maturity, should average, under good treatment, a growth of at least 500 feet per acre per annum, so that if a half million acres of the state were covered with pine, an annual crop of 250,000,000 feet of box boards would be produced, worth, at present

prices, about $4,000,000. This value would be still further enhanced from the fact that under good management, a considerable portion of the lumber would be building material instead of box boards. Some native white pine lumber has recently sold in Winsted for $90 per M. Much of the land growing chestnut would produce poles, under good management, instead of ties, thus giving a still greater revenue. Supposing that the remaining 700,000 acres of the state is unfit for the production of anything more valuable than cordwood, an average growth of one cord per acre per annum would amount, at $3.00 per cord, to $2,100,000.

To sum up, the total 1,500,000 acres should yield the land owners of the state an annual income, according to present prices, of at least $7,000,000. These figures are, of course, based on the value of the manufactured product, just as the value of the hay crop is based on its value after it is cured and in the barn; and the potato crop after it is cultivated, sprayed, hoed and in the cellar.

## Forestry Work.

For Connecticut, there are two main lines of forestry work of about equal importance: The improvement of the existing woodland, and the planting of unused land to valuable forest trees. The latter is the branch of forestry which appeals most strongly to the people, because the results from planting a field that has been covered with brush are evident in a few years; whereas it is difficult to distinguish any material change in the growth of a woodlot under treatment, except after a considerable series of years.

## Experiments in Planting—Windsor.

One of the first lines of work the Experiment Station started, on taking up forestry, was a series of experiments in forest planting. Two tracts of land were purchased in Windsor; one of about sixty acres of sand plain land, known as Lockwood Field, and the other, a rolling tract covered with sprouts and brush, known as Mundy Hollow, with a somewhat better soil. To the former of these fields has since been added fifty acres adjoining known as Clark Field. Lockwood Field was laid off in plots one acre in extent, and different experiments were

made on each, their object being to determine what species are best adapted to this type of land; what methods of planting are the most satisfactory and economical, and later, what distances of spacing and what subsequent treatment yield the best timber. These planting experiments were started in the spring of 1901, and have been continued up to the present, and are not yet complete. Mr. J. S. Leonard, of Rainbow, is local superintendent. The species which have been planted are as follows:

*Conifers.*
White Pine.
Norway Pine.
Scotch Pine.
Austrian Pine.
Pitch Pine.
Norway Spruce.
Red Fir.
Red Cedar.

*Deciduous Trees.*
Red Oak.
White Oak.
Chestnut.
Catalpa.
Cottonwood.
Basswood.
Tulip.
White Ash.
Green Ash.
Sugar Maple.
Beech.
Bitternut Hickory.
Black or Yellow Locust.
Black Birch.

Without question, the pines are thus far proving themselves very much better suited to this soil than any other trees. It is difficult to distinguish any material difference between the growth of white, Scotch and Norway pine, all of which are very thrifty, and are growing vigorously. The pitch and Austrian pines, although stocky, have somewhat of a recumbent habit thus far, though they will probably straighten up later. The soil is undoubtedly too dry for the spruces, though most of them are alive, and growing a few inches a year. The first plantations of pine were made in the spring of 1902. The average height of the white pine at the end of the growing season of 1904, i. e., after the third year's growth, was 26 inches. The average annual growth for 1905 and 1906 was 11 inches, so that the average height now is about four feet. Some trees have grown as much as 22 inches in a season and are now seven feet high. At this rate of growth, it will take a plantation of white pine seven years to reach the average height of six feet, at which height they may be exempted from taxation, according to Section 2320 of the Revised Statutes. After that they may be expected to grow much faster. Scotch pine of the same age

in the fall of 1904 was 19 inches high, and during the season of 1905 grew 12 inches, while Norway pine was 18 inches high in the fall of 1904, and grew 9 inches on the average in 1905. Scotch pine has the reputation of flourishing on the poorest sand soils, but its lumber is not equal to that of white pine and its growth does not hold out so well. One disadvantage of the white pine in Connecticut is that the leaders are often attacked by the white pine weevil. So far, however, only about one-half of one per cent. of the older plants have been affected by it.

All of these successful plantations of pine were started by planting two or three year old seedlings, seeding having proved a failure except in the case of pitch pine. The latter gave satisfactory results when two pounds of seed to the acre were used, though three pounds would evidently have been better. In all of the plantings, different distances of spacing have been tried,—4′ x 4′: 5′ x 5′; and 6′ x 6′.

Of the deciduous trees, the following have done best: White and red oak, chestnut, beech, black locust. A fair trial has been made of planting acorns and chestnuts, and the results indicate pretty conclusively that, while a fair stand of chestnut may be secured from nuts if the squirrels do not get at them, the results from acorns are even less assuring. By planting a bushel of chesnuts to the acre, satisfactory results have been obtained, but this means very close planting. An experiment in planting three nuts in holes 5′ x 5′ apart has, on the whole, turned out a failure, although the planting was done in furrows. One year seedlings of both oaks and chestnuts have proved quite satisfactory. Planting was done with a mattock, as in the case of conifers. The growth thus far made by the oaks and chestnuts is extremely small, as is also the case with the beech. These beech seedlings were two to four years old when planted. Some were collected in the locality, and some were purchased from nurserymen. The black or yellow locusts were one year seedlings and averaged about two feet high when set out in April, 1903. Many of these trees are now eight feet high and have already borne seed, so that natural reproduction may be expected in a year or two. So many questions are received regarding catalpa, that it should be noted that so far these trees have been killed back every winter, and so have made practically no advance since they were set out in April, 1903.

## Expense of Planting.

The cheapest planting is naturally that of acorns or chestnuts. In a good seed year a bushel of nuts can be bought for $3.50, and as the cost of planting these with a hoe or mattock is only about $2.00 an acre, the total cost amounts to about $5.50 an acre for chestnut and somewhat less for oak. As the results are scarcely satisfactory, it is advisable to invest a little more money in planting seedlings, which cost practically the same as pine. Nurserymen of this country are just beginning to produce seedlings on a large scale, at prices to induce forest planting. Their catalogs quote white pine seedlings at from $4.00 to $13.00 per thousand, and transplanted stock from $18.00 to $90.00 per thousand. Where one is assured of good stock arriving in satisfactory condition, $4.00 to $5.00 is a fair price for seedlings. One man can plant an average of one thousand per day, so the expense of purchasing and planting one acre 5 x 6 feet apart with 1500 of the $4.00 trees is about $8.60, or with 1,700 trees, i. e., 5 x 5 feet apart, about $10.00. Experience has shown that these distances of spacing give the most satisfactory results.

## Fire Protection.

From the first there has been a great deal of danger of our plantations in Windsor being destroyed by fires, which burn over the plains almost every year. Mundy Hollow, the tract of sprout land east of Poquonock, was twice burned over, destroying nearly everything which had been planted. An attempt was made to protect these plantations by plowed fire lines, but as they immediately grew up and proved ineffective, and as their expense was prohibitive when forest planting was intended as an investment, these fire lines were abandoned.

The fire lines on the plain land of Lockwood and Clark Fields, on the other hand, have been maintained and continued. Their condition steadily improves, so that after a line has been in use a year or so, it is only necessary to go over it with a harrow to keep it free from brush and grass. In constructing these lines, all trees and brush were uprooted, so that the initial expense of part of these lines was considerable. At first they were made ten feet wide and only 250 to 400 feet apart. In May, 1905, the plantations barely escaped destruction. A forest fire started in

Windsor Locks and burned for over twenty-four hours without receiving any attention, covering thousands of acres of sand plain land and gaining a frontage of several miles. About noon of the second day it reached Lockwood Field, and it was only by the utmost efforts of the planting crew of a dozen men and boys that the plantations were saved. Even with this assistance it would have been impossible to check the fire except for the fire lines, which proved highly valuable. As it was, the fire, which surrounded the field on three sides, twice jumped the lines and would have gone on had not men extinguished it before it gained headway. Experience with this fire proved that wider lines are advisable, even if there are not so many of them. If a fire can jump one ten foot line, the chances are that it may jump them all. Lines are now made fifteen feet wide and farther apart. Constructing these lines fifteen feet wide has cost about $80 a mile. The annual cost of keeping these lines in repair has been thus far about $15 per mile, but this is decreasing each year. The work of repair consists in cleaning out twice during the year, as in April and September. For a regular tract of 100 acres two miles of fire line should give good protection if kept in repair. For larger tracts the proportion of necessary mileage would be less.

The extra cost of labor for protecting the plantations from the fire above referred to was $16. One of the most effective ways of stopping the fire here was by throwing sand upon the advancing front. Where the bunch grass was too thick to permit this and the fire was exceedingly hot, it seemed that nothing could be done to check it. A horse and plow were finally secured, and two or three furrows served to control it.

### FOREST NURSERY, POQUONOCK.

Along with the beginnings in experimental plantations a nursery was started in Poquonock, partly to experiment in methods of raising trees from seed and partly to raise stock with which to supply the other experiments. The land rented for this purpose was an acre of good tobacco land about half a mile from the village. The present spring will terminate our use of this land, as a portion of the newly acquired Clark Field has been found good enough for nursery purposes. There is a great advantage in having the nursery near the plantations.

In connection with the nursery work observations have been made regarding the number of nuts per bushel of large seeded trees and number per ounce and pound of the lighter seeds.

| Species. | Number of seed per bushel. | Average weight per quart-lbs. |
|---|---|---|
| White oak | 9,500 | 3.5 |
| Red oak | 4,600 | 2.0 |
| Chestnut | 8,500 | |
| Bitternut hickory | 3,500 | 3.0 |
| Shagbark hickory | 3,000 | |

While there are several publications giving the percentage of germination of different forest seeds, this kind of information has been found of little use. The white pine, for example, is generally accredited with a germination per cent. of at least 70. Allowing 30,000 seed to the pound, one would expect to grow 21,000 seedlings, but experience shows that 5,000 to 10,000 is all that can be expected. The following gives the result of our experience with different species:

| Species. | Number of seed per ounce. | Number of seed per lb. | Number of one year seedlings from 1 lb. seed. |
|---|---|---|---|
| White pine | 1,640 | 26,240 | 7,350* |
| Scotch pine | 4,500 | 72,000 | 9,400 |
| Austrian pine | 2,096 | 33,536 | 5,800 |
| Norway spruce | 4,910 | 78,560 | 9,400 |
| Adirondack spruce | 8,600 | 137,600 | |
| White fir *(Abies concolor)* | 800 | 12,800 | 950 |
| Balsam fir | 4,277 | 68,400 | 4,000 |
| Hemlock | 9,800 | 156,800 | |
| Arbor vitae | 16,800 | 268,800 | 8,000 |
| European larch | 3,380 | 54,080 | 2,000 |
| Norway maple | 307 | 4,912 | |
| Sugar maple | 450 | 7,200 | |
| American elm | 2,680 | 42,880 | |
| Tulip | 400 | 6,400 | |
| Catalpa | 900 | 14,400 | 520 |
| Black locust | 1,456 | 23,296 | 2,280 |
| White ash | 750 | 12,000 | |

In planting heavy seeds as nuts in nursery, they are placed in rows about 18 inches apart and two to three inches apart in the rows.

* Average from 50 lbs.

The lighter seeds are sowed in beds. Both broadcasting and drills have been tried, and although drills seem to be generally preferred in European practice, we have found that with our unskilled labor broadcasting produces the best results. The seeds were often dropped too thickly in the drills, so that thick clumps resulted which had to be thinned out. For most of our coniferous seed we use a bed eighteen feet long and four feet wide, containing 72 square feet, for one pound of seed. The lath screens which are used for shading are six feet long, so three of these are required for a bed. Where the amount of germination is as high as is indicated in the previous table for white and Scotch pine, it is necessary to transplant some of the seedlings after the first year to prevent overcrowding. For such trees as the black locust a bed thirty feet long, containing 120 square feet, should be used for one pound of seed. The seeds are sown just as early in the spring as frost permits, usually in the first half of April, though often through May. The beds are kept well covered with a thick protection of leaves until the seeds germinate. The leaves are then removed, and the beds are shaded by a one-half shade of laths. In damp weather this is removed, as seedlings, especially those of pine, are liable to a disease known as "damping off" in wet weather. In the spring of 1905 this did serious damage in our old nursery, so that the average number of white pine seedlings raised from ten pounds of seed was only 2,500 per pound as against 7,350 per pound from 50 pounds in 1906 in our new nursery.

The following is an estimated inventory of the nursery stock in our old nursery at present (March, 1907). These seedlings are all two years old.

| | |
|---|---|
| White pine | 20,000 |
| Scotch pine | 4,500 |
| Austrian pine | 600 |
| Arbor vitae | 6,000 |
| Balsam fir | 3,700 |
| Norway spruce | 2,800 |
| European larch | 100 |
| Total | 37,700 |

These seedlings will be used almost entirely in continuing the experiments on Mundy Hollow and Clark Field.

In the spring of 1906 the new nursery was established with the intention of supplying nursery stock to private owners at a lower cost and in better condition than they can at present secure it. Following is an estimated inventory, made in the fall of 1906, of the stock in the new nursery, all of which is one year old:

| | |
|---|---|
| White pine | 367,200* |
| Scotch pine | 9,400 |
| Austrian pine | 5,800 |
| Norway spruce | 9,400 |
| Canary Island pine | 400† |
| Balsam fir | 8,000 |
| European larch | 2,000 |
| Red oak | 200 |
| Chestnut | 500 |
| Total | 402,900 |

*Summary*

| | |
|---|---|
| 2 yr. old seedlings | 37,700 |
| 1 yr. old seedlings | 402,900 |
| Total stock on hand | 440,600 |

## Assistance to Private Owners.

The plan which the Station has followed in giving assistance to private owners has differed somewhat from that pursued by the United States Forest Service, which was the originator of all forest work in this country. Most of the land owners in Connecticut are small farmers, who prefer getting first hand information by conversation with the forester to following a written working plan. Accordingly, the forester visits such tracts and advises the owners as to what land may be profitably planted, and what woodlots should be thinned. In advising a thinning, it is usually enough to mark an acre or so with the farmer, so that he will get an idea of just what trees are to be removed. However, if the owner wishes marked on the whole woodlot the trees which are to be cut, the forester has made arrangements with students of the Yale Forest School to do this work at $1.75 per day and their expenses. The cost of marking

* From 50 lbs. of seed.

† These were all killed by the winter.

amounts (according to the size of the trees and the area of the tract) to from twenty cents to fifty cents an acre.

In the same way very simple instructions are given regarding planting. Complicated mixtures are never advised, and for the most part pure white pine or chestnut are advocated. Every effort is made to keep in touch with farmers after the first examination of the land, and to assist them in securing nursery stock. Land owners planting five acres or more in a season may secure expert supervision of the planting if they desire. The forester takes charge of this himself as far as his time allows. When he is unable to give his personal attention to the matter, a forest student of experience is provided at $2.00 a day, plus expenses.

## Working Plans.

For large tracts of land it is unquestionably advisable to have a systematic plan of management covering a series of years, and this is especially so where the land is owned by a corporation, or a business man who cannot direct personally the management of the land. These plans are made by the Station to cover a period of ten years. The only expense to the owner for such a plan is that of the forester's expenses and those of assistance where this is required.

In order to show the nature of these working plans, we include here a plan made of a farm belonging to Mr. Chas. Beach of West Hartford.

## Condensed Working Plan.

The Mountain Spring Farm, situated in the towns of Farmington and Avon, the property of Charles M. Beach of West Hartford.

### *General Description.*

This farm is situated on the trap ridge which forms the division between West Hartford and Farmington, and has an elevation varying from 400 to 700 feet. A little over half the farm is agricultural; i. e., is either tillable or pasture. The remainder of the tract is largely of two main classes, woodland and brush land.

*Woodland.*

The woodland, which comprises about 308 acres, is of two types; old field pine and mixed hardwoods. It is largely confined to the rougher and more rocky portions of the tract. In restricted areas it occupies fairly level land with rather a good soil, but as a rule the soil is thin, and the result is a very slow-growing and under-developed forest for its age.

In order to improve the condition of the woodland an improvement thinning, such as that described in Bulletin 154 of this Station, is advised. Following is an estimate of the total amount of wood, and of the wood which should be removed. This estimate is given for the various subtypes of woodland.

| Name of type. | Area in acres. | Total volume in cords. | No. of cords to be removed. |
|---|---|---|---|
| Hemlock and hardwoods | 53.2 | 1,212 | 410 |
| Old hardwoods—poor quality | 37.2 | 750 | 186 |
| Young sprout forest | 36.6 | 366 | ... |
| Gray birch | 34.5 | 394 | 239 |
| Old hardwoods—good quality | 118.4 | 4,477 | 1,323 |
| Pine | 28.1 | 726 | 481 |
| Total rounded off | 308. | 7,905 | 2,639 |
| Average per acre | | 25.6 | 8.5 |

The above tables show a total volume of wood on the 308 acres of woodland of about 7,900 cords, of which fully 2,640 cords, or about 34 per cent. should be removed in the form of thinnings which will be made during the next ten years, an approximately equal area being thinned each year. The estimate here given is not indicative of the value of the woods, since a considerable portion of the stand could be cut into ties, poles, posts and some lumber. This 7,900 cords includes, for example, 4,800 (estimated) cedar fence posts.

*Age.*

Forty sample trees of various species and sizes and from all parts of the tract, were analyzed, and their ages were found to run from 22 to 62 years. The average age was 48.5 years, so it is fair to say that it has taken 48 years for the 308 acres of forest to produce 7,900 cords. This is an average of 164.6 cords

per year, or .53 of a cord per acre per annum. Good land without any particular care should average one cord per acre per annum, and it should be perfectly possible by treatment to bring this land up to this capacity.

The two main features of this plan of management for the next ten years are the thinning of 272 acres (the young sprout land will not be treated during this period) and the planting of 53 acres. About 27 acres will be thinned each year during the fall and winter, and the open land will be planted during five successive springs.

*Outline of Planting Work.*

| | |
|---|---|
| Block G. H. Area one acre pure white pine 5' x 6' = | 1,500 white pine. |
| Block G. I. Area 2 acres pure Scotch pine 5' x 6' = | 3,000 Scotch pine. |
| Block G. I. Area 4 acres chestnut and white pine 5' x 6' according to diagram. | |
| C P C P | 2,500 chestnut. |
| C P C P | 3,000 white pine. |
| Block G. I. Spread over 2 acres. White pine and Norway spruce 5' x 6' according to diagram. | |
| P S P S | 1,000 white pine. |
| P S P S | 1,000 Norway spruce. |
| P S P S | |
| Block G. J. One acre white pine and chestnut 5' x 6' according to diagram, as long as chestnut holds out, then solid pine. | |
| P C P C | 1,000 white pine. |
| P C P C | 500 chestnut. |
| Block G. One third of an acre on south of road near spring, pure white pine. | 500 white pine. |
| Block G. 9 acres white pine, pure, 5' x 5'. | 16,000 white pine. |
| Block G. G. 4.6 acres white pine, 3 yr. old stock 5' x 6'. | 6,900 3 yr. white pine. |
| Block G. K. 1.3 acres red or Norway pine 5' x 6'. | 1,885 red pine. |
| Block G. L. 7.7 acres Balsam fir 6' x 6' for Christmas greens. | 9,200 fir. |
| Block G. N. 1.1 acres European larch 5' x 5'. . | 1,870 larch. |
| Block G. O. 10 acres Norway spruce pure 5' x 6' for Christmas greens. | 12,000 spruce. |
| Block G. O. 8.7 acres red oak pure 5' x 5'. | 14,800 oak. |

ESTIMATED COST OF NURSERY STOCK.

| | |
|---|---|
| 23,000 white pine 2 yrs. old at $3.75 | $86.25 |
| 6,900 white pine 3 yrs. old at $5.45 | 37.60 |
| 13,000 Norway spruce 2 yrs. at $2.50 | 32.50 |
| 9,200 Balsam fir 2 yrs. at $4.00 | 36.80 |
| 3,000 Scotch pine 2 yrs. at $3.75 | 11.25 |
| 1,885 red pine 2 yrs. at $5.85 | 11.03 |
| 1,870 European larch 2 yrs. at $4.00 | 7.48 |
| 14,800 red oak 1 yr. at $3.00 | 44.40 |
| 3,000 chestnut at $3.00 | 9.00 |
| 76,655 | $276.31 |

A generous allowance for the cost of planting has been found to be $2.00 per 1,000, so the cost of planting 76,600 may be estimated at $153.00. Some of the land will require some clearing previous to planting. The average expense of this work may be estimated at $2.00 an acre.

SUMMARY OF ESTIMATED COST OF PLANTING 53 ACRES.

| | |
|---|---|
| Purchase of 76,655 seedlings | $276.31 |
| Cost of planting | 153.00 |
| Cost of brushing out land | 106.00 |
| | $535.31 |

The estimated total cost is at the average cost of $10 per acre.

*Conclusions as to Profit.*

As has been previously stated, the "plan" proposes to remove 2,640 cords from the tract during the next decade. Some of this wood is large enough for poles and ties and a few thousand feet of lumber, besides 4,800 fence posts. Altogether there should be a profit of at least 50 cents a cord over all expenses of marking, cutting, hauling, etc.

| | |
|---|---|
| Total estimated profit from 2,640 cords | $1,320.00 |
| Total estimated cost of planting 53 acres | 535.00 |
| Net profit at the end of decade | $785.00 |

This profit is, of course, only incidental, the main object of the management being to bring the non-agricultural part of the farm into a more productive capacity.

### *Management of the Tract after 1915.*

At the expiration of the period for which this plan is made, a forester should be employed to draw up a new plan for future management.

### *Accounts.*

It is very advisable that accurate accounts be kept of expenditures and receipts, for comparison with the estimates given in this report. The following form is suggested:—

| Date. | Block. | Description of expenditure or receipt. | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |

NOTE.—A map of the tract dividing the farm into blocks accompanied the above working plan.

## Forest Planting done by Middletown Water Company.

Mr. Mulford, the previous forester, made a working plan similar to the above for the Higby Mountain Reservoir tract, under the control of the Board of Water Commissioners of the City of Middletown. This plan called for the planting of 168 acres. Up to the present time the Board of Water Commissioners has expended on this work $1,662.50. 121,292 trees have been planted, as follows:

| Species. | 1903. | 1904. | 1905. | 1906. |
|---|---|---|---|---|
| Red oak ........ | 5,200 | .... | 15,793 | .... |
| Catalpa .......... | 3,500 | .... | .... | .... |
| Yellow oak ...... | 5,925 | 4,550 | .... | 7,525 |
| Chestnut ........ | 6,100 | 1,300 | 8,025 | .... |
| White oak ...... | 7,575 | .... | .... | .... |
| Red pine ........ | .... | 1,250 | .... | .... |
| White pine ...... | .... | 22,995 | 9,275 | 2,500 |
| Italian chestnut .. | .... | 124 | .... | .... |
| English walnut .. | .... | 80 | .... | .... |
| White ash ....... | .... | .... | 5,000 | .... |
| Swamp white oak | .... | .... | 7,575 | 6,000 |
| Tulip ............ | .... | .... | 1,000 | .... |
| Total ....... | 28,300 | 30,299 | 46,668 | 16,025 |

The total number of trees required to complete the planting plan is 81,558, or about 40 per cent.

The total area completely planted is 57.75 acres, and partly planted 59.25 acres, making 117 acres out of the 168 acres called for in the planting plan.

The past season 17 acres have been replanted with 8,000 oak and 1,050 chestnut plants.

Nine and one-half acres of swamp and wood lots have been thinned out in accordance with planting plan.

## Forest Seedlings Supplied at Cost.

There have been three main reasons why forest planting has been so neglected in New England: (1) Lack of knowledge about the proper species, methods and results obtainable; (2) Danger from fire; (3) Expense of forest tree seedlings.

As the Station had for some time given free advice regarding planting, when the General Assembly passed the law providing

for forest fire wardens, the one remaining step looking toward forest planting was to provide seedlings at a low cost to land owners who actually wished to establish forest plantations. Free distribution of seeds has been proved a failure by the National Government, and it was presumable that such a distribution of seedlings, even if money were appropriated for the purpose, would result in more harm than good. The Station therefore secured bids from the various nurserymen of the country for furnishing 100,000 white pine two-year-old seedlings for the spring planting of 1906. D. Hill of Dundee, Ill., offered these at $3.75 per thousand, and the order was accordingly given him. Order blanks were then sent to land owners of the state, who had consulted the forester, and these were filled in by them for such amounts as they desired, no orders for less than 1,000 seedlings being considered. A few land owners also secured other nursery stock through the Station. Below is a list of men who availed themselves of this opportunity, with a few remarks regarding the success of the plantations.

The Yale Forest School used 15,000 white pines on the tract of the Ansonia Water Company. Some of the bundles were heated, and were therefore discarded. Most of those planted proved satisfactory.

Dr. William H. Sage of Woodbury used 2,000 white pine.

Mr. Daniel Webster of Berlin used 2,000 chestnut.

The Vine Hill Farm Company of Newington used on the Mountain Spring Farm in Farmington: 2,500 chestnut; 15,000 white pine; 3,000 Scotch pine; 1,000 Norway spruce. Almost every one of the chestnuts have lived, and the evergreens have proved thoroughly satisfactory considering the very dry spring.

Mr. Toscan Bennett planted in Farmington: 4,000 white pine; 2,000 Scotch pine; 1,000 balsam fir; 500 Norway spruce. The firs were older and especially thrifty stock, and are doing finely. The other trees are very satisfactory.

Mr. J. Edward Heaton planted at the foot of Mount Carmel 20,000 white pine. Some of the bundles were badly heated on arrival. For a few weeks after planting it seemed that there had been a heavy loss, but later rains developed signs of life in many trees which were apparently dead. About 20 per cent. of the stand failed. D. Hill has made good this loss, which was largely due to poor packing.

Dr. Charles Mallory Williams planted 3,000 white pine in Stonington. Dr. Williams inspected the plantation in November, and estimated that 80 per cent. had lived, which he considered satisfactory considering the rough treatment they had before planting.

Miss Mary Dreier planted 3,000 white pine in Stonington.

The Hotchkiss School in Lakeville planted 1,000 white pine.

Mr. H. F. Schwarz of Greenwich planted 2,000 white pine. These were too tightly packed, and proved unsatisfactory.

Mr. Chester Child of Putnam planted 3,000 white pine.

Mr. Newman Hungerford planted in Harwinton: 500 catalpa; 300 white oak; 500 chestnut; 500 black locust; 1,500 white pine. Mr. Hungerford reports that his plantations were doing well until the cows got in and trampled and ate off the tops, especially of the chestnut. The locust survived the best.

Mr. Charles Atwood of Watertown planted 1,500 white pine. Inspection in the fall indicated a difference in planting, as in some rows all the trees were living, while in others there was considerable loss.

Mr. J. T. McKnight of Ellington planted 2,000 white pine. Many of the bunches were badly heated on arrival.

Mr. James W. Thompson planted 1,000 white pine in Bridgeport.

Miss Kate A. Willcox planted 1,000 white pine in Westport.

Mr. Edwin C. Davis of Somers planted 1,000 white pine. The railroad company held these in the Windsor station for a week, so that they arrived in bad condition.

Mr. John C. North of New Haven planted 1,000 white pine.

Mr. John M. Paine of Putnam planted 1,000 white pine. He reports that most of these are doing well.

The Connecticut Agricultural College planted 1,000 white pine.

Altogether there were planted in some seventeen towns of the state by private owners or corporations:

| | | | |
|---|---|---|---|
| 79,000 | white pine. | 500 | black locust. |
| 5,000 | chestnut. | 500 | catalpa. |
| 5,000 | Scotch pine. | 300 | white oak. |
| 1,500 | Norway spruce. | | |
| 1,000 | Balsam fir. | 92,800 | total. |

With the exception of cases where bundles were tied too tightly or were too closely packed, the stock proved satisfactory.

Obviously, if the stock can be raised in Connecticut, it will reach the planters in better condition.

## Dissemination of Information.

In order to spread information about forestry throughout the state, Bulletin 154, entitled "Chestnut in Connecticut, and the Improvement of the Woodlot", was published after a careful study of chestnut growth in various parts of the state. Illustrated lectures and talks on forestry have been given before several granges, women's clubs, village improvement societies and other bodies.

## State Forests.

While literature and talks have unquestionably been productive of increased interest in the subject, the most effective way of arousing interest is by means of examples. This is the primary purpose of state forests, of which there are now two in Connecticut, one in Portland and one in Union. Besides serving as an object lesson to farmers of the neighborhood, these forests are excellent investments for the state. It is generally recognized that land values, especially those of woodland, are rising. Wealthy men are acquiring large tracts, and woodland purchased now for $4.00 an acre or less will double in value in ten years, even at the most conservative estimates. The towns in which these tracts are located profit especially, of course, for the state pays taxes on the value of its land just as the private owner. As the land improves in value under good management, the assessed value will increase. The other local advantages, such as the example to private owners, the future supply of larger timber than would be raised by farmers, the employment of local labor, the protection from fire, and consequently added security of adjoining owners, and in some cases the protection of local water supplies;—all tend to make these state forests of value to the inhabitants and towns.

## Portland Forest.

The state forest of Portland and Chatham consists of 1,100 acres purchased at an average cost of $1.75 per acre. This is located on the west slope of Meshomasick Mountain, and for

the most part is land which has always been wooded, but has been repeatedly cut off, so that it is covered with sprout growths, largely of chestnut, varying in age from one to forty years. A few of the lots were formerly pastures, and are now overgrown with birch and other brush. The main line of forestry work for this tract is the improvement of the growth by thinnings, and for the past three winters such thinnings have been made in lots where the trees were about 25 years old. Five or six cords per acre are removed, consisting of the poorer trees which interfere with the development of the best trees.

The wood, which is about half chestnut, and is largely round stuff of small sizes, is sold for charcoal to a local burner at $1.25 a cord piled in the woods. The only planting done thus far in this reserve is that of a few small areas on which chestnuts have been planted. Three nuts in a hole were used in planting some of the old pasture lands, and where these escaped the notice of squirrels, they have done very well. On the whole, it seems that seedlings are more satisfactory.

The local superintendent, Mr. John C. Reeves, in charge of this reserve has been particularly fortunate in protecting the tract from fire, so that since the first purchase no part of the area has been burned. While his services for patrol duty averaged for two years about ten cents per acre per annum, this could undoubtedly be decreased relatively if the area was considerably enlarged.

In coöperation with the United States Forest Service the Station has established some permanent sample plots on this tract, on which for a definite series of years the effect of thinning on growth and seedling reproduction may be accurately studied.

## Union Forest.

The state land in Union is of a very different character. It consists of 300 acres of abandoned farms purchased at an average cost of $3.57 an acre, being partly hill pastures and old mowings, and partly woodland. The former owners reserved the right for three years to cut the lumber, but certain seed trees and groups of half-grown pine were purchased with the hope of securing natural reproduction on part of the cut-over land. To secure good pine reproduction two or three seed trees per acre, i. e., pines with large tops, should be reserved.

In the spring of 1906, about 15 acres of the old mowings were planted with 20,000 two-year white pine 5 x 6 feet. With labor at $1.75 per day, the average cost of planting 1,000 trees was $1.66. In other words, a man could plant a little over 1,000 trees a day on the average. The method employed here was to use a crew of three men planting with mattock and one man carrying the plants in a basket, who was kept busy handing them to the other three. It was possible to plant in fairly straight lines by setting three poles at each end of the field and in the middle to sight on. This planting was done early in April, when the ground was still very wet, and as the trees arrived in excellent condition, the plantation was an entire success, although, of course, the trees did not make any growth the first year.

Dr. Schenck, forester of the Vanderbilt estate at Biltmore, offered one year white pine seedlings for sale at $2.50 per thousand, and 20,000 of these yearlings were planted in drills on land which had been plowed and harrowed. It was thought that these could be set out in our nursery and grown for a year at a cost making them more economical than the two-year stock purchased at $3.75; and at the same time producing a more thrifty and acclimated stock. While the latter result may be realized, the cost of setting them out in nursery beds amounted to $1.27 per thousand, so that with 15 cents per thousand for transportation and 25 cents for weeding, they have already cost over $4.00. These seedlings will be used for continuing the planting work either this year or next.

The cut-over pine land is covered with tops and brush of an inflammable nature, which will be disposed of as soon as the cordwood has been removed. In the meantime a fire line has been cleared for protective purposes. This was made by hauling into the open and burning, all the tops within ten or fifteen feet on either side of an old highway. In case of fire this would furnish a good position for setting back fire. The construction of this line cost about $30 a mile.

The boundaries of this reserve, as well as the one at Portland, are marked by iron bounds set at the corners, each one being numbered for location on the map, and bearing the initials C. S. F. (Connecticut State Forest).

State forests have thus been started in Middlesex and Tolland counties. It is the Station's policy as soon as funds become available to establish similar tracts in the other counties of the

state, so that all land owners will have easy access to these examples of forestry.

## Forest Fires.

The greatest menace to the woodland of Connecticut, as in fact in all parts of the United States, is fire. This is not so much on account of the actual wood destroyed, but because young seedlings are killed, the soil is impoverished, and great areas of land are thus kept from becoming productive. Three years ago, despite the fact that woodland is taxed more heavily relative to its value than any other property, there was no protection for such property against fire. In 1905 the General Assembly passed a law based on that of some other states, establishing a fire warden system looking toward the protection of this wooded half of the state. According to this law, Chapter 238, Public Acts of 1905:—

The state forester is ex officio state forest fire warden without additional salary. He has supervision of town fire wardens, and may cause violations of the laws regarding forest fires to be prosecuted.

Upon his request, and with his approval, the selectmen appoint town fire wardens for the term of one year. These officers may divide their towns into districts and appoint men as district wardens in charge of these. Up to the present (March 1, 1907) 138 towns have thus appointed wardens. Of the 30 remaining towns many are cities, and a change of the law is necessary to provide for the protection of woodlands in their outlying districts. Besides the town wardens, 211 district wardens have been appointed, so that altogether there is a force of 350 men responsible for the protection of the woodlands of the state from fire.

The work of these wardens is to prevent and extinguish forest fires in their respective towns. "Forest fires" means here fires in brushland as well as woodland. The fire wardens have control and direction of all persons and apparatus while engaged in extinguishing forest fires outside the limits of cities and boroughs. Fire wardens may arrest without warrant persons taken in the act of violating the laws for the protection of woodland.

During seasons of drought, the town fire wardens may establish a fire patrol. In case of fire, wardens are to make use of

all necessary means for confining and extinguishing such fires, and may even set back fires in an emergency. They may also destroy fences and plow land; and they may summon any male resident of the town between the ages of 18 and 50 years to assist in extinguishing fires, and may also require the use of horses and other property needed for fighting fire.

Wardens are paid 25 cents an hour while they are employed, and their assistants are paid at a price fixed by the town, not over 20 cents per hour. Bills for services are audited by the selectmen, and on their approval are paid by the town treasurer. The town is reimbursed one-quarter of the expense by the state and one-quarter by the county.

This law went into effect in August, 1905, and the matter was immediately called to the attention of the selectmen of the various towns. Forty-four towns appointed wardens whose duties began October 1, 1905. Owing to the fact that this is a new office, it was only after persistent correspondence that 138 towns have finally made appointments.

In order to obtain some idea of the damage done by fires previous to the inauguration of the fire warden system, the fire wardens were asked to report on the fires of 1905, and the following reports were received covering only the period previous to the appointment of the wardens:

### Report of Fires for 1905 by 42 Wardens.

*Avon.*—W. E. Smith reported 100 acres burned over, with a damage of $250. 100 cords of piled wood were burned.

*Bloomfield.*—M. H. Barnard reported about 500 acres burned with a damage of $1,000 or more. There are fires here nearly every year caused by the railroad.

*Canterbury.*—A. Hale Bennett reported about twenty acres burned, with a damage of $50. About ten years ago there was an extensive fire started by the railroad which burned a large territory and caused a damage of fully $1,500.

*Chaplin.*—Don C. Hattin reported 50 acres burned over, with a damage of $200. In 1903 there was a bad fire here which burned over 125 acres, with a damage of $500.

*Cheshire.*—Henry E. Terrell reported that 100 acres of sprout land were burned over, with a damage of $500.

*Clinton.*—Holcomb N. Jones reported 150 acres burned, with damage of $150. In October or November, 1903, a fire burned over 200 acres of young wood, causing a damage of $400 or over.

*Columbia.*—T. G. Tucker reported no fires for the year. In April or May, 1895, two serious fires occurred.

*Darien.*—Abel Dance reported 2,000 acres burned. Damage is not estimated.

*Glastonbury.*—William S. Chamberlain reported 600 acres burned over with a damage of $600.

*Goshen.*—John P. Porter reported no fires for the year.

*Griswold.*—J. B. Sweet reported very few fires with little damage in 1905. In spring of 1903 a forest fire burned over about 200 acres, damaging it so badly that it had to be cut off. It consisted partly of timber and partly of young growth.

*Groton.*—Amos R. Chapman reported 300 acres burned, with a damage of perhaps $500. In October, 1902, there was a bad fire which spread over more than 600 acres of wood and brush land, causing a damage of over $1,500.

*Hamden.*—J. C. Doolittle reported no fires for the year. In spring of 1903 a fire burned over 60 acres, causing a damage of $300.

*Harwinton.*—John A. Mansfield reported about 100 acres burned over, with a damage of over $300. In the last seven or eight years there have been ten fires, all occurring in April, burning fully 600 acres, and causing a damage of fully $1,500.

*Killingly.*—Sidney Bastow reported about 300 acres burned over with a damage of about $2,000.

*Killingworth.*—D. Merton Stevens reported 15 acres burned, with a damage of $25.

*Lebanon.*—Marcus M. Hazen reported 500 acres burned, with a damage of $250.

*Litchfield.*—Edson L. Perkins reported no fires for the year. In 1902 a fire burned over 150 acres near Bantam, causing a damage of $150.

*Manchester.*—John D. Stone reported 200 acres burned, with a damage of $3,000. On May 2, 1905, about one mile east of Manchester, in the town of Glastonbury, there was a fire that burned 600 acres or more of woodland and pasture, destroying about 500 feet of lumber, 2,000 ties and 900 fence posts.

*Monroe.*—George Burr reported no fires. Sparks from

engines have caused serious fires, destroying cordwood, killing standing timber and acres of sprouts.

*New Canaan.*—Arthur L. Benedict reported 60 or 80 acres known to have been burned over, and probably more. In October, 1904, about 2,000 acres were burned over, killing most of the young growth and seriously damaging many larger trees. "I would estimate the average amount of damage during the last decade to be not less than $1,000 a year."

*North Haven.*—Lawrence Bruce reported 200 acres of pasture land and brush land burned over, with a damage of $248; 47 acres of woodland, damage $142; meadow land and fences, with a damage of $125; making a total damage of about $500.

*Oxford.*—Frederick W. Hubbell reported over 200 acres burned, with a damage of fully $500. This represents the annual damages, as many fires are set by railroads.

*Portland.*—W. B. Synnott reported about 100 acres of timber land burned over. Fires in this town are usually caused by hunters, and occur in the fall.

*Putnam.*—Herman G. Carver reported no fires.

*Salem.*—H. A. Rathbun reported 10 or 15 acres burned over, with a slight damage.

*Scotland.*—Dwight H. Barstow reported no fires for the year. Ten years ago there was a bad fire in the south part of the town.

*Stamford.*—Frank V. Stevens, Jr., reported 80 acres burned, with a damage of $2,500.

*Sterling.*—Joseph Shippee reported that he did not know of any fires in 1905.

*Stonington.*—Charles H. Eccleston, Jr., reported no fires for the year.

*Suffield.*—E. N. Austin reported 600 to 1,000 acres burned over, resulting in a damage of several thousand dollars. Every May or other dry spell hundreds of acres of plain land covered with woods are burned.

*Union.*—George Towne reported 200 acres burned, with a damage of $3,000.

*Voluntown.*—Walter C. Tanner reported 300 acres burned with a damage of $1,000. Between the years 1898 and 1903 there were several fires, burning over heavy timber valued at $10,000, the greater part of which was pine and oak.

*Warren.*—David Strong reported no fires for the year. In the spring of 1904 about 300 acres were burned over, with a

damage of possibly $1,500. Within the last five years there have been three or four big fires, burning over from 200 to 1,000 acres.

*Washington.*—Merrill F. Fenn reported 260 acres burned over, with a damage of fully $1,600. (This is the owner's estimate.) There were other fires not estimated.

*Watertown.*—Simeon M. Jones reported no fires for the year. There were bad fires in the spring of 1901 and the fall of 1902.

*Wethersfield.*—Levi B. Churchill reported 68 acres burned, with a damage of $125.

*Willington.*—E. C. Eldridge reported 40 to 60 acres of timber land burned over, with a damage of $100 to $200. In 1902 a fire burned over 50 acres of sprouts, destroying 1,000 cords of wood, with a loss of $1,500. In 1901 a fire burned over 60 acres of sprouts.

*Windsor Locks.*—H. W. Seymour reported 800 acres burned over, with a damage of $5,000.

*Woodbridge.*—Charles P. Augur reported about 50 acres burned over, with a damage of $1,000. A part of the burned area was occupied by cordwood, 30 to 40 cords per acre. The balance was sprout land. "Nearly every year in April forest fires occur. I remember several within the past thirty years which caused damage running up into four figures. Some sprout land is burned over so often that it never gets beyond sprout land."

*Woodbury.*—Asahel Mitchell reported no fires for the year. "All our fires the past few years have done comparatively little damage, as they have been on brush land that would not make timber in several generations."

*Woodstock.*—Charles W. Perrin reported no fires for 1905. In October 1904, a fire occurred in the west part of the town, burning about 15,000 feet of stacked lumber, estimated value $150. In same year about 30 acres of sprout and timber land were burned, with a damage of $1,500. Fires were mostly set by fishermen.

## SUMMARY.

While the reports from these forty-two towns indicate that there are few really large fires in the state, yet the aggregate amount of damage done by them year after year is a most important factor in the present unproductive condition of so much of the state. The fire warden of Woodbury fails to under-

stand the significance of these fires when he says that the fires do little damage because they are on brush land that would not make timber in several generations. It is due to repeated fires that the land is not more productive. There is little land in the state that would not have produced a good wood crop in a generation under good protection.

Reports from these forty-two towns indicate that from 8,000 to 10,000 acres were burned over in the year 1905 within their areas. It is impossible to accurately estimate the damage from such fires. That given by the wardens would indicate an annual damage of from $30,000 to $40,000. If the injury to the soil and young growth was taken into consideration, the estimated damage would probably be greater. But if these forty-two towns are considered representative of the 168 towns of the whole state, the conclusion must be that fires throughout the state, previous to the new law, burned over from 30,000 to 40,000 acres, with a damage of from $120,000 to $160,000 or more.

During the first year of the fire warden service reports were received from 66 towns. In 35 of these towns 88 fires were reported, of which 64 were extinguished by the wardens and their assistants at a total expense of $464.56, or an average of $7.25 per fire. The expense to the state was $116; to the various counties, $116; to the 22 towns in which the fires occurred, $232.28, or an average of $10.55 per town.

By this expenditure of less than $500 there is no doubt that as many thousand dollars worth of property was saved from destruction. And one must also take into consideration that the posting of notices and wide advertisement of the new law were influential in greatly diminishing the number of fires, so that there is already an increased feeling of security on the part of many land owners. In fact, the general concensus of opinion seems to be highly favorable to the new system.

Of the 88 fires reported for the year 1906:

| | | | |
|---|---|---|---|
| 30 | were | attributed to | the N. Y., N. H. & H. R. R. Co. |
| 10 | " | " | brush burners. |
| 2 | " | " | hunters. |
| 12 | " | " | miscellaneous causes. |
| 34 | " | " | causes unknown. |

f these fires occurred in April and 25 in May, while the rest were scattered throughout the year.

# TESTS OF THE VITALITY OF VEGETABLE SEEDS.

By E. H. Jenkins.

During 1905 four hundred and twenty-five samples of field and garden seeds have been tested as to their sprouting capacity, at the request of seed growers and purchasers. During 1906 two hundred and eighty-eight samples were thus tested. This work was done by Mr. Churchill, following the methods adopted by the Association of American Agricultural Colleges and Experiment Stations. As the size of this report is strictly limited, details regarding these tests are omitted and only a brief summary is given of the results.

### *Comparison of the Vitality of Crops of Connecticut-Grown Onion Seed in the Years 1894–1906.*

The average sprouting capacity of Connecticut-grown onion seed, less than one year old, as determined for a number of years at this station, has been as follows:

Table I.—Vitality of Crops of Onion Seed.

| | No. of Samples tested. | Average Percentage sprouted. |
|---|---|---|
| In 1880 | 14 | 87.0 |
| 1894 | 25 | 82.9 |
| 1895 | 13 | 85.5 |
| 1896 | 44 | 72.4 |
| 1897 | 39 | 77.9 |
| 1898 | 68 | 69.3 |
| 1899 | 62 | 89.0 |
| 1900 | 77 | 88.5 |
| 1901 | 60 | 71.0 |
| 1902 | 60 | 80.6 |
| 1903 | 59 | 62.0 |
| 1904 | 42 | 80.4 |
| 1905 | 37 | 78.6 |
| 1906 | 62 | 77.2 |

Average for 13 consecutive years, 77.7 per cent.

The sprouting capacity of the onion seed raised in 1903 is much lower than that of this crop in any other year of which we have knowledge, and growers explain this by the exceptionally wet and cold summer season of that year.

### *The Sprouting Capacity of Different Varieties.*

The average sprouting capacity of five varieties, of which a considerable number of samples have been tested, is as follows (only those samples are here included which were alleged to be less than one year old at the time of testing and were grown in Connecticut):

TABLE II.—SPROUTING CAPACITY OF DIFFERENT VARIETIES OF ONION SEED.

| Variety. | No. of Samples tested. | Average Percentage of sprouting Seed. |
|---|---|---|
| Yellow Globe ...... | 256 | 75.0 |
| Red Globe ........ | 209 | 80.2 |
| White Globe ...... | 138 | 77.3 |
| White Portugal ... | 31 | 69.7 |
| Wethersfield Red .. | 14 | 79.9 |

### *Vitality of Onion Seed as Affected by the Age of the Seed.*

Since November 1, 1896, the station has examined 1,084 samples of onion seed of the crop of 1896 and of each succeeding crop. The results are summarized in the following table.

It is quite clear that as a rule a larger percentage of California-grown onion seed germinates than of Connecticut-grown seed. It is also quite clear that, as a rule, onion seed one year old has a much lower sprouting capacity than new seed, though there are many exceptions to this. Seed from a good crop when one year old will sometimes germinate quite as well as new seed from an inferior crop.

TABLE III.—VITALITY OF ONION SEED.

| | Connecticut Grown. | | Cal. Grown. | |
|---|---|---|---|---|
| | No. of Samples. | Per cent Sprouted. | No. of Samples. | Per cent Sprouted. |
| Seed stated to be less than one year old ........... | 573 | 75.38 | 215 | 89.55 |
| Seed stated to be between one and two years old... | 122 | 61.81 | 128 | 79.08 |
| Seed stated to be between two and three years old | 24 | 21.90 | 20 | 57.53 |
| Seed stated to be between three and four years old | 1 | 59.50 | 1 | 10.00 |

### *Vitality of Sweet Corn Seed.*

The following table gives the average, maximum and minimum vitality found in tests of Connecticut-grown sweet corn less than one year old during the years 1904, 1905 and 1906.

| | No. of Samples tested. | Average Percentage by number of Seed sprouting. | Maximum. | Minimum. |
|---|---|---|---|---|
| Country Gentleman ...... | 7 | 92.5 | 98.0 | 83.0 |
| Early Crosby less than one year old ............... | 10 | 96.5 | 100.0 | 91.0 |
| Early Crosby *one to two* years old .............. | 4 | 63.6 | 85.0 | 42.0 |
| Early Evergreen less than one year old ........... | 3 | 87.8 | 96.0 | 82.0 |
| Early *Evergreen one to* two years old ......... | 1 | 91.0 | .... | .... |
| "Evergreen" less than one year old ............... | 1 | 88.0 | .... | .... |
| "Evergreen" one to two years old ............. | 3 | 80.7 | 92.0 | 73.0 |
| Acme Evergreen one to two years old .......... | 1 | 80.0 | .... | .... |
| Hickox .................. | 2 | 92.5 | 96.0 | 89.0 |
| Metropolitan ............. | 1 | 99.0 | .... | .... |
| Old Colony less than one year old ............... | 3 | 88.7 | 95.0 | 81.0 |
| Old Colony one to two years old .............. | 1 | 80.0 | .... | .... |
| Old Colony two to three years old .............. | 1 | 45.0 | .... | .... |
| Stowells Evergreen less than one year old ..... | 18 | 88.1 | 100.0 | 73.0 |
| Stowells Evergreen one to two years old .......... | 4 | 86.0 | 99.0 | 64.0 |
| Early Dawn ............. | 1 | 96.0 | .... | .... |

# TESTS OF THOROUGHBRED GUERNSEY COWS FOR ADVANCED REGISTRY.

On request of the Guernsey Cattle Club the station has made monthly tests of the weights of milk and butter-fat given by Guernsey cows which had been entered for advanced registry.

Since the last report on this subject some of the six cows whose tests had been completed have been admitted to advanced registry.

Tests of twenty-two other cows have been undertaken. Two have been withdrawn. Ten cows are now under test, ten have been tested, and of these eight have secured advanced registry. The records of the advanced registry cows are as follows:

| | | Age in Years. | Pounds of Milk. | Pounds of Butter-fat. | Average per cent Butter-fat. |
|---|---|---|---|---|---|
| *Owner, Howard B. Tuttle, Naugatuck.* | | | | | |
| Lettie Lenfestey, | 14986 | 2½–3 | 5,433.0 | 285.77 | 5.26 |
| Loretta Lenfestey | 14988 | 2½–3 | 6,687.6 | 387.69 | 5.80 |
| Princess Idalia, | 14990 | 2½–3 | 6,986.5 | 341.40 | 4.89 |
| Bessette, | 15089 | 2½–3 | 7,777.4 | 398.19 | 5.12 |
| Leucadia, | 18609 | 2–2½ | 6,568.8 | 328.25 | 5.01 |
| Luca Lenfestey, | 19307 | 2–2½ | 4,819.3 | 272.31 | 5.60 |
| *Owner, A. A. Pope, Farmington.* | | | | | |
| Jennie Wonder, | 14330 | 4–4½ | 7,195.9 | 404.08 | 5.61 |
| Eileen, | 16359 | 3–3½ | 6,494.6 | 333.60 | 5.13 |
| Anita of Hillstead, | 16644 | 2–2½ | 7,618.8 | 351.94 | 4.62 |
| *Owner, R. & H. Scoville, Chapinville.* | | | | | |
| Zetta, | 12773 | Over 5 | 7,799.5 | 425.39 | 5.45 |
| Miranda of Grassland, | 14125 | " " | 10,114.1 | 444.39 | 4.39 |
| Giloola, | 16403 | 4–4½ | 8,370.6 | 380.87 | 4.55 |

## ERRATA.

Page 44, second line from bottom, for "analyes" read analyses.
108, tenth line, for "report" read reported.
109, second line, for "months" read month.
147, eleventh line, after "were" insert of.
154, twentieth line, for "in" read is.
thirtieth line, for "charge" read change.
164, eighteenth line, for "power" read powder.
170, third line from bottom, for "purity" read impurity.
178, eleventh line, for "202" read 204. For "to" read and.
twelfth line, for "14" read 15.
fifth line from bottom, for "to" read and.
179, twentieth line, for "to" read and.
180, eighteenth line, for "to" read and.
180, twentieth line, for phrase "and breweries" read, whose chief *product is brewer's grits.*
191, twelfth line from bottom, for "difference" read differences.
*194, sixth line from bottom, insert of before $24.86.*
202, Niagara White Middlings should be classed with winter *wheat middlings.*
223, second line, read "have" for has and "are" for is.
240, second line, for "if needed" read where necessary.
243, sixth line, for "was" read were.
253, twentieth line, for "137" read 138.
301, twelfth line from bottom, for "850" read 350.
fifth line from bottom, for "were" read was.
306, tenth line, for "larva" read larvæ.
308, ninth line, for "Puccina" read Puccinia.
344, seventh line, strike out "that" after seedlings.
twenty-third line, for "depends" read depend.
364, eleventh line, for "any" read an.

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